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**AUSTRALIAN**

# **RAINBOW**

**April, 1986**

**No.58**



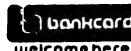
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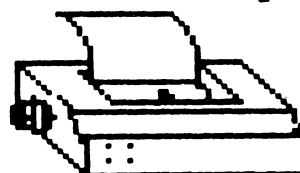
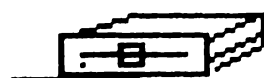
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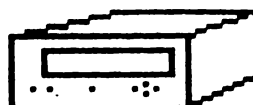
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Australian Rainbow Magazine. (Dec '81 to now.)  
Australian CoCo Magazine. (Aug '84 to now.)  
CoCoBug Magazine. For CoCo — usually 8 programs in each magazine. (Sep '84 to Oct '85)  
Australian MiCo Magazine. For Tandy MC 10 computers. (Dec '83 to Jul '84)  
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# RAINBOW Info

## How To Read Rainbow

Please note that all the BASIC program listings you find in THE RAINBOW are formatted for a 32-character screen — so they show up just as they do on your CoCo screen. One easy way to check on the accuracy of your typing is to compare what character "goes under" what. If the characters match — and your line endings come out the same — you have a pretty good way of knowing that your typing is accurate.

We also have "key boxes" to show you the *minimum* system a program needs. But, *do* read the text before you start typing.

Finally, the little cassette symbol on the table of contents and at the beginning of articles indicates that the program is available through our RAINBOW ON TAPE service. An order form for this service is on the insert card bound in the magazine.

## What's A CoCo

CoCo is an affectionate name that was first given to the Tandy Color Computer by its many fans, users and owners.

However, when we use the term CoCo, we refer to both the Tandy Color Computer and the TDP System-100 Computer. It is easier than using both of the "given" names throughout THE RAINBOW.

In most cases, when a specific computer is mentioned, the application is for that specific computer. However, since the TDP System-100 and Tandy Color are, for all purposes, the same computer in a different case, these terms are almost always interchangeable.

## The Rainbow Check Plus



The small box you see accompanying a program listing in THE RAINBOW is a "check sum" system, which is designed to help you type in programs accurately.

*Rainbow Check PLUS* counts the number and values of characters you type in. You can then compare the number you get to those printed in THE RAINBOW. On longer programs, some benchmark lines are given. When you reach the end of one of those lines with your typing, simply check to see if the numbers match.

To use *Rainbow Check PLUS*, type in the program and *CSAVE* it for later use, then type in the command *RUN* and press *ENTER*. Once the program has run, type *NEW* and *ENTER* to remove it from the area where the program you're typing in will go.

Now, while keying in a listing from THE RAINBOW, whenever you press the down-arrow key, your CoCo gives the check sum based on the length and content of the program in memory. This is to check against the numbers printed in THE RAINBOW. If your number is different, check the listing carefully to be sure you typed in the correct BASIC program code. For more details on this helpful utility, refer to H. Allen Curtis' article on Page 21 of the February 1984 RAINBOW.

Since *Rainbow Check PLUS* counts spaces and punctuation, be sure to type in the listing exactly the way it's given in the magazine.

```
10 CLS:X=256*PEEK(35)+178
20 CLEAR 25,X-1
30 X=256*PEEK(35)+178
40 FOR Z=X TO X+77
50 READ Y:W=W+Y:PRINT Z,Y;W
60 POKE Z,Y:NEXT
70 IF W=7985 THEN B0 ELSE PRINT
  "DATA ERROR":STOP
80 EXEC X:END
90 DATA 182, 1, 106, 167, 140, 60, 134
100 DATA 126, 183, 1, 106, 190, 1, 107
110 DATA 175, 140, 50, 48, 140, 4, 191
120 DATA 1, 107, 57, 129, 10, 38, 38
130 DATA 52, 22, 79, 158, 25, 230, 129
140 DATA 39, 12, 171, 128, 171, 128
150 DATA 230, 132, 38, 250, 48, 1, 32
160 DATA 240, 183, 2, 222, 48, 140, 14
170 DATA 159, 166, 166, 132, 26, 254
180 DATA 189, 173, 198, 53, 22, 126, 0
190 DATA 0, 135, 255, 134, 40, 55
200 DATA 51, 52, 41, 0
```

## Using Machine Language

Machine language programs are one of the features of THE RAINBOW. There are a number of ways to "get" these programs into memory so you can operate them.

The easiest way is by using an editor/assembler, a program you can purchase from a number of sources.

An editor/assembler allows you to enter mnemonics into your CoCo and then have the editor/assembler assemble them into specific instructions that are understood by the 6809 chip that controls your computer.

When you use an editor/assembler, all you have to do, essentially, is copy the relevant instructions from THE RAINBOW's listing into CoCo.

Another method of getting an assembly language listing into CoCo is called "hand assembly." As the name implies, you do the assembly by hand. This can *sometimes* cause problems when you have to set up an *ORIGIN* statement or an *EQUATE*. In short, you have to know something about assembly to hand-assemble some programs.

Use the following program if you wish to hand-assemble machine language listings:

```
10 CLEAR200,&H3F00:I=&H3F80
20 PRINT "ADDRESS:";HEX$(I);
30 INPUT "BYTE:";B$
40 POKE I,VAL("&H"+B$)
50 I=I+1:GOTO 20
```

This program assumes you have a 16K CoCo. If you have 32K, change the &H3F00 in Line 10 to &H7F00 and change the value of I to &H7F80.

## The Crew

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**Special Thanks to**  
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Alex Hartmann, Michael Horn,  
Darcy O'Toole, Martha Gritwhistle,  
Geoff Fiala, John Redmond  
and Mike Turk.

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### Deadlines:

7th of the preceeding month.

### Printed by:

Australian Rainbow Magazine  
P.O. Box 1742

Southport, Qld. 4215.

Registered Publication QBG 4009.

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Before you read any further, if you are a subscriber, please check your mailing label.

We've been working on some of the glitches in our database, and as part of this task, have reallocated many numbers.

As a reminder, your subscriber's number is the number in the top left hand area of the mailing label. Then follows the renewal dates for the various items to which you subscribe. We replace the '8' in '86' with a code letter, except if you only receive Australian Rainbow Magazine. Some of the more usual code letters include

- B - Both Australian Rainbow & Australian CoCo
- I - Australian CoCo
- C - CoCoOz
- R - Australian Rainbow on Tape.

Of course we supply many more items than these on subscription, more details can be found on the Goldsoft pages towards the end of this magazine.

We've been having a bit of a tidy up this month - not just with the Data Base but also with some of our equipment.

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I have two grey case CoCo's here neither works well. One merges programs automatically, and probably does other nasty things too, the other is just weird. Both are fitted with Video Amps.

We've decided to make these available to HACKERS only at \$160 each. If you are not into hardware and solder and chips and that sort of gear, don't even ask.

We also have a pair of Remex double sided drives for sale. One works, the other I would only use for spares.

Remex drives are a bit strange, but they are good gear if you know your hardware. Again, we would only be interested in selling these to someone who knows what he/she is doing, for \$200 the pair.

We have a couple of printers to sell too. However as these will not be released from their current duties for another month or so, I will advise you of these next month.

CoCoConf'86 plans are starting to gel.

It appears that Education will be a major tutorial area on its own this year, as will the MS DOS / T1000 section.

The whole thing seems to be growing very quickly around me - and I confess a little surprise at the keen attitude of many who have already booked to come.

We did have a great time last year, and many of last year's participants have booked just on the strength of that meeting.

I will, in fact, be finalising the list of tutorials and tutorial leaders for publication next month.

The latest tutorial to be offered is one by Bob Delbourgo, whose subject will be "The Use of CoCos in Education". This is a tutorial anyone with even a remote interest in Education will not want to miss!

On the commercial side, a number of suppliers have committed themselves to being at CoCoConf'86, including The Computer Hut from Bowen, Paris Radio, Queensland Colour Software Supplies, and Geoff Fiala (who makes THE printer interface for CoCo!).

So how about it?

The conference is on, it is on at a great time of the year to be somewhere else, and if you come, you're going to see some of the most interesting and innovative gear available. You'll also learn from Australia's foremost CoCo teachers; and you'll get the chance to meet many of the famous contributors to the CoCo scene.

What's more, the venue is one which draws visitors back to the coast year after year.

You can't miss this year - reserve your place - we need to know now if you are going to be here!

Finally, our zanny mate Andrew White, has come up with a few suggestions for those who own a Commodore 64 and don't quite know what to do with it. Andrew has some ideas for interfacing it to the real world.

Look for Andrew's timely hints in next month's Australian CoCo!

*John*

# Educating with Electronic Communications and Research

By Michael Plog, Ph.D.

---

**I**n case you have not tried your free hour on the Delphi telecommunications network, I strongly encourage you to take advantage of this offer from THE RAINBOW. Like many of you, I have been playing around with Delphi for a while now, trying to learn the shortest way to get from one point to another.

The folks who created the Delphi system must have been poets, because the name itself implies majesty, mystery and a reference to answers. "Delphi" was a special place to the ancient Greeks. It was the most important Greek temple and home of the oracle of Apollo. Also, the Greeks considered Delphi to be the center of the world. In the temple itself, a stone marked the exact spot of the world's center, called the "navel."

The term "oracle" is actually a Latin word, not Greek. Traditionally, the oracle at Delphi belonged first to Mother Earth. Apollo either stole the oracle or was given it by Mother Earth. The medium of the oracle (the person actually doing the speaking) was always a woman over 50. The procedures to obtain an answer from the oracle were complex and rigid. A "reading" could only be given at certain times of the year. A ritual cake was required, along with a sacrificial animal conforming to rigorous physical standards.

The oracle and her consultants bathed in a special spring, drank from a sacred stream, then entered the temple. The oracle went to a basement cell in the temple, sat on a sacred tripod and chewed leaves of the laurel tree (this was Apollo's special tree). While sitting and chewing on the leaves, the oracle would

speak. Her words, however, were not given directly to the person asking the question. They were interpreted and written by the priests, often in highly ambiguous verse.

Delphi has been continuously inhabited since the 14th century B.C. The height of the oracle's prestige and popularity was in the 4th century B.C.

When you stop and think about it, the present electronic Delphi is somewhat similar to the ancient oracle. People approach with a question or a need for information. It is always helpful to have a ritual cake (maybe a sandwich, but I find it easier to use a cookie). The sacrificial animal has been replaced with a plastic credit card, but still requires rigorous standards. (If you don't pay, you don't stay.) Your computer does not have to be in a basement, but you are figuratively apart from the rest of the world. The messages we receive from our electronic oracle are sometimes ambiguous.

I have learned a few things while on Delphi, other than about the system itself. It seems that everyone wants a RAINBOWfest held in a city close to where they live. Most of the Color Computer users responding to a poll have one or more disk drives. Of the 29 respondents to one poll, 75 percent of them use more than one disk operating system for their Color Computer. I have also read some interesting messages about modems and operating systems, and have obtained some public domain software.

I wonder about educational applications of Delphi for schools and students. It seems that two major applica-

tions can be expected. First is the communication potential of Delphi. You can send messages to other people (perhaps those having some special expertise) and share ideas with others of a similar interest. The second benefit for education is the research capabilities of Delphi.

The idea of communicating with other people with similar interests is important for the field of education. Several bulletin board services exist for special interest groups in education. These services connect people with similar interests and can serve many functions. For example, local school districts can send applications for special funding to state agencies or foundations by electronic means. One special interest group, educators for the handicapped, has an electronic communications service with one of the features being updates on proposed legislation. Subscribers know what is being discussed in Washington and have an ideal opportunity to contact their representatives and encourage a vote one way or the other.

Electronic research capabilities have revolutionized decision making in business and government, but not yet in schools. Delphi has a connection with a system called DIALOG, a collection of over 200 databases. Some of these are highly specialized, technical databases, such as medical experiments or legal search organizations. A person might want to know how many microcomputers were sold to schools last year; searching the appropriate database provides the answer.

The problems involved in using elec-

# Building Language Arts Skills

By Steve Blyn

**B**ack to basics" skills are the trend in many school systems throughout the country. This renewed emphasis on the traditional language arts and math skills is probably the most popular way computers are currently being used in schools. These types of programs are commonly referred to as C.A.I. — Computer-Assisted Instruction.

Way before the age of computers arrived, there existed many wonderful skill series of language arts workbooks. One such series is published by Barnell Loft, Ltd. These workbooks cover a wide range of skills, including following directions, using the context, locating the answer, getting the facts, getting the main idea and drawing conclusions. The individual booklets are available for the first grade up to high school level.

Almost every school I have visited uses some of these skill booklets. I have used them in my classroom for several

*Steve Blyn teaches both exceptional and gifted children, holds two master's degrees and has won awards for the design of programs to aid the handicapped. He owns Computer Island and lives in Staten Island, New York.*

years. This month's program is an all-purpose language arts program. It is easily adaptable to any of the ideas presented in such skill books.

By varying the types of questions, this program can be geared to any of the mentioned skill areas. Similarly, the program can be made suitable for almost any level by changing the story content as well as the questions.

One might ask, "Why is it necessary to replicate on the computer what already exists in booklet form?" Tsk! Tsk! There are several very good reasons.

Computers may be presenting similar material, but through a very different medium. Children are naturally attracted to computers and sometimes learn better through them than by traditional means. Computers have the ability to give immediate feedback to the student — you know at every step of the way whether you are succeeding or not.

Computers are also impersonal. By that, I don't mean they don't have any personality. Morris, my original CoCo, is very dear to me and has practically become a family member. (We do celebrate his birthday.) By impersonal, I mean they are tireless reformers of

mistakes. They do not complain to the user, nor do they make any judgments against the user. It is almost impossible for a person to remain impartial to successes and failures as computers do.

The program presents part of the "Jack and the Beanstalk" story. This is located on lines 90 and 100. Our story is merely used as an example. The choice of story and the grade level for which it is written should be yours. The story of Jack was taken from a third-grade reader.

A series of questions about the story is placed in the DATA lines 260-390. Our questions use a scattered approach: They purposely do not cover any one specific skill area. They are meant to illustrate the variety of questions you may use. They even go beyond the Barnell Loft areas mentioned earlier. Your questions can be as diverse as your imagination or just remain with one skill area.

Fourteen questions were entered as illustrations. We chose the number 14 to show you that we are not limited only to 10 questions. Often, computer newcomers think there is something magical about the number 10 or its multiples. Not so! A short program such as this one can have literally hundreds of questions entered. You must, however,

tronic research are generally cost and training. The price for using some of the databases can be very high. Some of the specialized databases can cost thousands of dollars per year, plus online connection time. Most schools are not willing to incur such expenses for student projects. Also, each database requires special procedures for searching. Those procedures can become complex for the untrained person.

I believe these problems will be eliminated in the near future. The procedures for specialized searching are a matter of software. Computer profes-

sionals are currently working on new languages to help the human and machine understand each other better. The cost factor may be a little more difficult to solve. It is expensive to maintain even a simple database — a lot of time is required (which must be paid for by someone). A lot of expensive equipment is also necessary to provide a database. The more people who use such systems, however, the less each will have to pay.

Will we ever reach a time when electronic communications and research are common practices for elementary and secondary students? Will we have,

for example, a sixth-grade student in Florida writing a report about earthquakes, and including as part of that report, an interview with a California student who recently experienced an earthquake?

The future is unknown; our current Delphi oracles only share present information, not future happenings. However, if you or your school is using electronic communications or research, I would like to know about it. Please share your experiences and efforts. My Delphi username is MPLOG — why not drop me a line? □



tell the computer how many questions to read. Our number of questions is indicated in the dimension statement on Line 30 and also on lines 40 and 50. Be sure to include the number of questions you use on those lines.

The program is set to ask 10 of the story questions each round. Common sense dictates that rounds come in sets of 10 questions. Other numbers that divide evenly into 100 are also good choices. The questions appear one at a time and do not repeat in a given round.

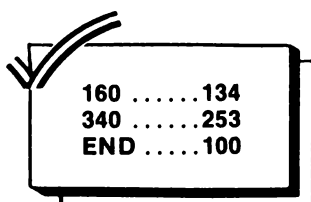
Correct answers receive a happy tune

and a message that says "correct" on Line 210. The incorrect answers, however, are really the important ones. Each time a question is answered incorrectly, its question and correct answer are stored in lines 400-420. This makes possible a review of these questions and answers. This is similar to a study-review sheet.

The program handles the review on lines 430-480. If you have a printer, it is a good idea to print out the review for the student's future reference. To get a printout, change the PRINT statements

on lines 430, 440 and 460 to PRINT#-2, statements. You may add these to the existing lines to get the output on both the screen and the printer.

It is hoped that you use this program as a model for incorporating your own versions. You may create fun programs to reinforce children's favorite stories or programs to strictly strengthen specific language arts skills. A combination of the two might be the best route to go. Remember to save each of your versions on tape or disk before proceeding to your next creation. □



The listing: FINDWORD

```

10 REM"FIND THE WORD"
20 REM"STEVE BLYN, COMPUTER ISLAND, NY, 1986
30 DIM A$(14), B$(14), X$(10), Y$(10)
40 FOR T=1 TO 14:READ A$(T), B$(T):NEXT T
50 R=RND(14)
60 XY=RND(-TIMER)
70 CLS
80 PRINT@32, STRING$(32, 207);
90 PRINT"    JACK CLIMBED THE BEANSTALK A SECOND TIME. HE WAS AGAIN HELPED BY THE GIANT'S WIFE. THIS TIME HE TOOK THE HEN THAT LAID THE GOLDEN EGGS. HE ESCAPED QUICKLY.";
100 PRINT"    JACK PICKED UP THE MAGIC HARP ON HIS THIRD TRIP. BUT THE HARP CALLED OUT AND WOKE THE GIANT. THE GIANT BEGAN TO CHASE JACK."
110 N=N+1
120 PRINT@0, "N=";N;          ** JACK ** R=";CR;
130 IF N>10 THEN GOTO 430
140 PRINT@352, STRING$(32, (RND(128)+127));
150 PRINT@416, STRING$(95, " ");
160 PRINT@384, "TRY TO FIND THE WORD THAT..."
170 IF R>13 THEN R=0
180 R=R+1
190 PRINTA$(R)
200 INPUT C$
210 IF C$=B$(R) THEN PLAY"L100CEGCEGCC":PRINT"CORRECT. PRESS ENTER TO GO ON";:CR=CR+1
220 IF C$<>B$(R) THEN PLAY "L4CC

```

```

":PRINTB$(R)" IS THE ANSWER.";:GOSUB 400
230 EN$=INKEY$
240 IF EN$=CHR$(13) THEN 110
250 GOTO 230
260 DATA IS A COMPOUND WORD, BEANSTALK
270 DATA IS A COLOR, GOLDEN
280 DATA HAS AN APOSTROPHE, GIANT'S
290 DATA IS THE OPPOSITE OF HUSBAND, WIFE
300 DATA IS GOOD TO EAT FOR BREAKFAST, EGGS
310 DATA MEANS MORE THAN TWO TIMES, THIRD
320 DATA MEANS THE OPPOSITE OF SMALL, GIANT
330 DATA MEANS THE SAME AS FAST, QUICKLY
340 DATA MEANS THE SAME AS A VOYAGE, TRIP
350 DATA IS THE NAME OF AN ANIMAL, HEN
360 DATA IS A MUSICAL INSTRUMENT, HARP
370 DATA IS THE OPPOSITE OF IN, OUT
380 DATA THAT APPEARS MOST OFTEN ABOVE, THE
390 DATA THAT IS USED 4 TIMES, JACK
400 X$(J)=A$(R):Y$(J)=B$(R)
410 J=J+1
420 RETURN
430 CLS:PLAY"CDEFG":PRINT"HERE IS YOUR REVIEW"
440 IF CR=10 THEN PRINT:PRINT"VERY GOOD ... 100%":GOTO 490
450 FOR K=0 TO J-1
460 PRINT K+1;". ";Y$(K); " IS THE WORD THAT":PRINTX$(K):PRINT
470 EN$=INKEY$
480 IF EN$=CHR$(13) THEN NEXT K ELSE 470
490 END

```

*A nonviolent game for children . . .*



# Set your Sails, Keep a Weather Eye out for Storms and Beware of the Jolly Roger!

By David Compton

**S**everal times I have seen in the pages of RAINBOW a plea for non violent games for children. World Trader is written for the young child, perhaps a second or third grader. Even younger children can use it with parental help. World Trader is a text Adventure, but the reading is kept to a minimum. It essentially seeks to teach children the names of some countries and the products for which they are best known. The player can't "lose" the game; he is just sent back to the beginning to start over. At the same time, there is an element of excitement - pirates or storms may strike at any moment, costing you money, or you may arrive in a country to sell your goods, only to find that your customers aren't interested!

All of the instructions are given at the beginning of the game, but here's a summary: The idea is to earn \$25,000 or more by buying merchandise in one country and selling it at a profit in another. Note that you may have only one of each item in your hold at any one time. Only four commands are needed by the player, GO, which presents a list of 10 countries you may travel to; BUY, which displays what the inhabitants have for sale (and reduces your cash on hand if you decide to buy); SELL, which disposes of your cargo and updates your cash; and INV, which informs you what's in your cargo hold. The player must also bear in mind that each time he uses the command GO, his funds are reduced by \$100 salaries for the crew. The first few trips should be made carefully, or the captain (you) will quickly run out of money.

130	.....88
280	.....11
460	.....81
600	.....252
END	.....230

## The listing: TRADER

```

10 'TRADER
12 ' BY DAVID COMPTON, 252 N. MA
IN ST., SUFFIELD, CT 06078
13 'COPYRIGHT 1985
20 CLS
30 AA$="THE GAME OF":BB$="WORLD
TRADER":PRINT@208-(LEN(AA$)*.5),
AA$:PRINT@272-(LEN(BB$)*.5),BB$
40 FOR DL=1TO2000:NEXT:CLS
50 PRINT" IN THIS GAME, YOU STA

```

```

RT WITH A SHIP AND $1000. THE O
BJECT IS TO TRAVEL AROUND THE W
RLD, BUYING AND SELLING, UNTIL
YOU EITHER RUN OUT OF MONEY
OR EARN ENOUGH TO RETIRE."
60 PRINT" EACH VOYAGE WILL COST
YOU $100. IN ADDITION, YOU'
LL HAVE TO BE CAREFUL OF PIRATE
S AND STORMS."
70 PRINT" YOUR CREW UNDERSTANDS
THE COM-MANDS 'GO', 'BUY', 'SEL
L' AND 'INV' (INVENTORY)."
80 PRINT@448,"PRESS ANY KEY TO B
EGIN"
90 IFINKEY$=""THEN90
100 CLS
110 WE=1000:W$="$ $ ##, ###"
120 DIMCN$(10,8)
130 DATA BRAZIL,BRAZILIANS,COFFE
E,500,0,RELICS,2000,0
140 DATA HOLLAND,DUTCH,CHOCOLATE
,100,0,DIAMONDS,10000,0
150 DATA FRANCE,FRENCH,WINE,1000
,0,CHEESE,250,0
160 DATA GERMANY,GERMANS,BEER,30
0,0,CLOTHING,1000,0
170 DATA NORWAY,NORWEGIANS,FISH,
200,0,CRYSTAL,5000,0
180 DATA CHINA,CHINESE,TEA,100,0
,SPICES,2000,0
190 DATA ARGENTINA,ARGENTINES,BE
EF,1000,0,HORSES,3000,0
200 DATA ITALY,ITALIANS,PASTA,35
0,0,STATUES,6000,0
210 DATA DENMARK,DANES,FURNITURE
,5000,0,CLOTH,1000,0
220 DATA INDIA,INDIANS,IVORY,850
0,0,FABRICS,700,0
230 FORX=1TO10:FORY=1TO8:READCN$
(X,Y):NEXTY,X
240 PRINT"YOU BEGIN YOUR VOYAGE
IN LONDON.YOU HAVE":PRINTUSINGW
$:WE
250 PRINTSTRING$(32,"$");
260 IFWE>24999THENPRINT"YOU HAVE
":PRINTUSINGW$:WE:PRINT"A SUCCE
SSFUL VOYAGE! YOU RETURN TO ENGL
AND IN TRIUMPH!" :END
270 PRINT"YOUR ORDERS,SIR?"
280 INPUTO$
290 IFO$="SELL"THENGOTO420
300 IFO$="BUY"THENGOTO560
310 IFO$="GO"THENFORX=1TO10:PRIN
TX:CN$(X,1):NEXT:GOTO340

```

continued on Page 10



# Invasion of the Flying Saucer People

By Allen B. Carlisle

If you like fast action games that challenge your reflexes and offer different skill levels, you will like *Saucer*. The scenario goes something like this: You are on a desolate planet, and while safe from attack from the dreaded Saucer people from within your base camp (lower right-hand corner of the graphics screen), you must venture out to get the supply boxes, which are present at the lower left-hand corner of the graphics screen. The moment you venture out, or your robot ventures out (for those who abhor violence), a saucer enters the scene and randomly flies around shooting its laser beam at you. If you are hit, another man, or robot, exits the base and heads for the needed supplies. Each player gets four men per round.

You are not left without defense, however, as you can shoot back by skillful use of the right joystick. Of

course, the firebutton activates your laser gun, but aiming it takes a few attempts to master. Each time you succeed in knocking out a saucer, 100 points are scored. Aiming your gun involves watching a blinking cursor at the uppermost horizontal part of the screen or the far left vertical position of the graphics screen. Your ray fires at that cursor position as you press the button. Movement to the right of the joystick causes the cursor to appear at the top, while movement to the left moves the cursor to the left vertical part of the screen. Up on the joystick causes the cursor to move up the screen if it is at the left vertical position, and to the left if it is at the upper horizontal position. Of course, down performs the opposite movements.

When I decided to write *Saucer*, I knew the main mathematical task would be to obtain the formula that

calculates the coordinates of the point on a line (laser ray) that is on the segment perpendicular to some other point off the line (center of the saucer). After having looked in all my analytical geometry texts, I found nothing that would give me what I needed, so I took some time to derive the formulae I needed. Line 1090 of this program is what gives the coordinates of this point (LX,LY), where (A,B) and (C,D) are two points of the laser beam shot at the saucer and (X,Y) is the coordinate of the center of the saucer. The actual distance is calculated in Line 1100.

Variable QED is the test variable for this distance, which is larger for the lower skill level so that at skill level one, the beam does not necessarily have to touch the saucer in order to score a hit, but must be very close.

Good luck knocking those nasty Saucer people from the sky! □

250 .....32 970 .....154  
380 .....182 1110 .....112  
610 .....74 END .....254  
770 .....138

## The listing: SAUCER

```
10 REM SAUCER *****
20 REM (C) ALLEN B. CARLISLE 198
5****
30 REM ALL RIGHTS RESERVED*****
*
40 '*****
50 '*****
60 REM INITIALIZE GAME
70 CLS:PCLEAR4:POKE65495,0
80 DIMA$(4):DIMA(4):INPUT"NUMBER
  OF PLAYERS";ZZ
```

```
90 FOR PL=1 TO ZZ:CLS:INPUT"ENTE
  R NAMES";A$(PL):NEXT:CLS:PL=1
100 INPUT"SKILL LEVEL(1-5)";L
110 IF L<1 OR L>5 THEN 100 ELSE
  L=ABS(INT(L))
120 IF L=1 THEN 130 ELSE 140
130 DIS=0:QED=17:GOTO250
140 IF L=2 THEN 150 ELSE 160
150 DIS=1:QED=15:GOTO250
160 IF L=3 THEN 170 ELSE 180
170 DIS=3:QED=13:GOTO250
180 IF L=4 THEN 190 ELSE 200
190 DIS=3:QED=10:GOTO250
200 DIS=3:QED=8:GOTO250
210 IF PL>ZZ THEN PL=1
220 A(PL)=A(PL)+SCR
230 IF MEN=0 THEN PL=PL+1
240 IF MEN=0 THEN GOTO1170 ELSE
  RETURN
250 REM DRAW SAUCER & GET IT
260 PMODE4,1:U=214:SCREEN1,1:PCL
  S0:MEN=8
```

```
270 H1=20:H2=44:V1=7:V2=7:V3=7:V
  4=7:FL=-1:BOX=0:M=92
280 FOR I=1 TO 4: LINE(H1,V3)-(H
  2,V4),PSET:LINE(H1,V1)-(H2,V2),P
  SET
290 H1=H1+1:H2=H2-1:V1=V1-1:V2=V
  2-1:V3=V3+1:V4=V4+1:PSET(31,2):P
  SET(32,2):NEXT
300 DIMS(12,26):GET(19,1)-(45,13
  ),S,G:LINE(19,1)-(45,13),PRESET,
  BF
310 REM DRAW & GET ROBOT
320 DRAW"BM217,180R3D1L3R2D6L1U3
  L1;B;U1L2U1;B;D9R1U1;B;R1U2;B;R3
  D1;B;R1;B;D1D1L1"
330 DIMR(11,8):GET(214,180)-(222
  ,191),R,G
340 REM DRAW BASE
350 LINE(240,164)-(255,191),PSET
  ,BF:LINE(228,176)-(244,191),PSET
  ,BF
```

```

360 FOR I=168 TO 184 STEP 8:LINE
(248,I)-(251,I+3),PRESET,BF:NEXT
370 LINE(232,184)-(235,187),PRES
ET,BF:LINE(240,184)-(243,187),PR
ESET,BF
380 REM DRAW SUPPLY BOXES
390 FOR I=0 TO 88 STEP 8
400 LINE(I,180)-(I+3,191),PSET,B
:NEXT:SCREEN1,1
410 REM ENTER SAUCER
420 FOR I=0 TO 128 STEP 8
430 W=20
440 PUT(I,20)-(I+26,32),S,PSET
450 LINE(I,20)-(I+26,32),PRESET,
BF
460 ABR=RND(9):IF ABR=2 THEN 480
ELSENEXT
470 GOTO 490
480 GOTO 510
490 I=128:PUT(I,W)-(I+26,W+12),S
,PSET:GOTO510
500 REM MOVE SAUCER
510 Q1=RND(0):IF Q1<.5 THEN A=-1
ELSE A=1
520 Q2=RND(0):IF Q2<.5 THEN B=-1
ELSE B=1:H=RND(6):V=RND(6)
530 H=H*A:V=V*B:L=RND(20)
540 FOR E=1 TO L
550 IF I>226 THEN 630
560 IF W>140 THEN 630
570 IF I<0 THEN 630
580 IF W<0 THEN 630
590 PUT(I,W)-(I+26,W+12),S,PSET:
X=I:Y=W
600 GOSUB 640
610 LINE(I,W)-(I+26,W+12),PRESET
,BF:I=I+H:W=W+V
620 NEXT:GOTO630
630 PUT(X,Y)-(X+26,Y+12),S,PSET:
GOSUB780:FOR DLY=1 TO 2:SOUND216
,1:SOUND226,1:GOSUB 820:NEXT:I=X
:W=Y:GOSUB860:GOTO510
640 REM MOVE ROBOT
650 GOSUB860
660 IF FL>0 THEN 700
670 LINE(U,180)-(U+8,191),PRESET
,BF:U=U-1:PUT(U,180)-(U+8,191),R
,PSET
680 IF M=U THEN 690 ELSE RETURN
690 FL=FL*-1:BOX=BOX+1:IF BOX=1
THEN 750 ELSE U=U-8
700 IF U<0 THEN U=0
710 LINE(U,180)-(U+13,191),PRESE

```

```

T,BF:PUT(U,180)-(U+13,191),B,PSE
T:U=U+1
720 IF U=215 THEN 730 ELSE RETUR
N
730 LINE(U,180)-(U+13,191),PRESE
T,BF:FL=FL*-1:U=214:PUT(U,180)-(
U+13,191),R,PSET
740 M=M-8:SCR=1000:GOSUB210:IF M
<4 THEN 1250 ELSE RETURN
750 REM GET ROBOT & BOX
760 DIMB(11,13):GET(87,180)-(100
,191),B,G:U=87:GOTO 700
770 REM SHOOT LASER BEAM
780 XX=X+13:L=U+4:R1=RND(5):R2=R
ND(5):R3=RND(5):R=R1+R2+R3
790 IF L-9+R<0 THEN R=9
800 LINE(XX,Y)-(L-8+R,191),PSET:
FOR DLY=1 TO 40:NEXT
810 LINE(XX,Y)-(L-8+R,191),PRESE
T:RETURN
820 IF ABS(R-8)<=DIS THEN 830 EL
SE RETURN
830 LINE(U,180)-(U+8,191),PRESET
,BF:MEN=MEN-1
840 SCR=0
850 U=214:FL=-1:GOSUB210:RETURN
860 REM ROBOT SHOOTS
870 K=PEEK(65280):IF K=126 OR K=
254 THEN 1020
880 J0=JOYSTK(0):J1=JOYSTK(1)
890 IF J1>54 THEN UN=UN+8
900 IF J1>45 AND J1<=54 THEN UN=
UN+5
910 IF J1>36 AND J1<=45 THEN UN=
UN+2
920 IF J1>27 AND J1<=36 THEN UN=
UN
930 IF J1>18 AND J1<=27 THEN UN=
UN-2
940 IF J1>9 AND J1<=18 THEN UN=U
N-5
950 IF J1>=0 AND J1<=9 THEN UN=U
N-8
960 IF UN<0 THEN UN=0
970 IF J0>32 THEN 1000
980 IF UN>160 THEN UN=160
990 LINE(0,UN)-(4,UN+4),PSET,BF
:LINE(0,UN)-(4,UN+4),PRESET,BF:R
ETURN
1000 IF UN>254 THEN UN=254
1010 LINE(UN,0)-(UN+4,4),PSET,BF
:LINE(UN,0)-(UN+4,4),PRESET,BF:R
ETURN

```

```

1020 IF J0>32 THEN 1050
1030 A=0:B=UN:C=U:D=180
1040 LINE(0,UN)-(U,180),PSET:FOR
DLY=1TO2:SOUND216,1:SOUND226,1:
NEXT:GOSUB1070:LINE(0,UN)-(U,180
),PRESET:RETURN
1050 LINE(UN,0)-(U,180),PSET:A=U
N:B=0:C=U:D=180
1060 FORDLY=1TO2:SOUND216,1:SOUN
D226,1:NEXT:GOSUB1070:LINE(UN,0)
-(U,180),PRESET:RETURN
1070 REM CHECK IF SAUCER HIT
1080 X=X+13:Y=Y+6
1090 LX=(X*(C-A)^2+A*(D-B)^2+(D-
B)*(C-A)*(Y-B))/((D-B)^2+(C-A)^2
):LY=(B*(C-A)^2+Y*(B-D)^2+(B-D)*
(C-A)*(A-X))/((D-B)^2+(C-A)^2)
1100 IF SQR((LY-Y)^2+(LX-X)^2)<=
QED THEN 1120
1110 X=X-13:Y=Y-6:FORDLY=1TOX:AB
R=RND(0):NEXT:RETURN
1120 REM SAUCER HIT
1130 LINE(I,W)-(I+26,W+12),PRESE
T,BF:FORDLY=1TO20:SOUND200,1:RH=
RND(26):RV=RND(12):PSET(I+RH,W+R
V):NEXT:X=X-13:Y=Y-6
1140 LINE(I,W)-(I+26,W+12),PRESE
T,BF
1150 IF J0>32 THEN LINE(UN,0)-(U
,180),PRESETELSELINE(0,UN)-(U,18
0),PRESET
1160 SCR=1000:GOSUB210:GOTO410
1170 CLS:FORK=1 TO ZZ:PRINT0(64+
K*64),A$(K);"S SCORE=";A(K):NE
XT
1180 PRINT0384,"TO END GAME PRES
S 'E'":PRINT0352,"NEXT ROUND PRE
SS 'N'"
1190 B$=INKEY$:IF B$="E"THEN1260
ELSE IFB$="N"THEN1220ELSEIFFLAG=
1THENRETURNELSE1190
1200 IF FLAG=1THENRETURN
1210 CLS
1220 IF PL>ZZ THEN PL=1
1230 PRINT0230,"R E A D Y ";A$(P
L);:FORDLY=1TO 5000:NEXT
1240 LINE(X,Y)-(X+26,Y+12),PRESE
T,BF:SCREEN1,1:MEN=8:GOTO410
1250 CLS:PRINT0103,"G A M E O V
E R !!!":NEXT:FOR DLY=1 TO 150
00:NEXT:FLAG=1:GOSUB1170
1260 POKE113,0:EXEC40999

```

continued from Page 3

```

320 IFO$="INV"THENGOTO720
330 PRINT"I DON'T UNDERSTAND, CA
PTAIN":GOTO250
340 INPUTDE:IFDE<1ORDE>10THEN250
350 GOSUB670
360 CLS:L$=CN$(DE,1):PRINT"YOU A
RE IN ";CN$(DE,1)
370 WE=WE-100
380 PRINT"YOU HAVE";:PRINTUSINGW
$;WE
390 IFWE<0THENPRINT"WE'RE OUT OF
MONEY, CAPTAIN. WE'LL HAVE T
O RETURN TO ENGLAND TO GET A LOA
N.":FORX=1TO2000:NEXT:END
400 GOTO250
410 *****SELL*****
420 FORD=1TO10:IFCN$(D,5)="1"THE
N450ELSENEXTD
430 FORD=1TO10:IFCN$(D,8)="1"THE
N450ELSENEXTD
440 PRINT"YOU HAVE NOTHING TO SE
LL.":GOTO270
450 IFRND(10)=6THENPRINT"THE ";C
N$(DE,2);" AREN'T":PRINT"INTERES
TED IN BUYING.":O$="GO":GOTO310
460 PRINT"THE ";CN$(DE,2);" WILL
BUY ";

```

```

470 FORX=1TO10:IFCN$(X,5)="1"THE
NPRINTCN$(X,3):PRINT"SOLD FOR";:
PRINTUSINGW$;VAL(CN$(X,4))+(.3*V
AL(CN$(X,4))):WE=WE+VAL(CN$(X,4)
)+(.3*VAL(CN$(X,4)))
480 CN$(X,5)="0"
490 NEXTX
500 FORD=1TO10:IFCN$(X,8)="1"THE
NPRINTCN$(X,6):PRINT"SOLD FOR";:
PRINTUSINGW$;VAL(CN$(X,7))+(.3*V
AL(CN$(X,7))):WE=WE+VAL(CN$(X,7)
)+(.3*VAL(CN$(X,7)))
510 CN$(X,8)="0"
520 NEXTX
530 PRINT"YOU HAVE";:PRINTUSINGW
$;WE
540 GOTO250
550 *****BUY*****
560 PRINT"THE ";CN$(DE,2);" WISH
TO SELL.":PRINTCN$(DE,3);:PRINT
USINGW$;VAL(CN$(DE,4)):PRINTCN$(
DE,6);:PRINTUSINGW$;VAL(CN$(DE,7
))
570 PRINT"WHICH WILL YOU BUY?"
580 INPUTB$
590 IFB$<>CN$(DE,3)ANDB$<>CN$(
DE,6)THENPRINT"THEY DON'T HAVE A
NY FOR SALE"
600 IFB$=CN$(DE,3)THENIFWE<VAL(
CN$(DE,4))THENPRINT"NOT ENOUGH M
ONEY":GOTO250

```

```

610 IFB$=CN$(DE,6)THENIFWE<VAL(
CN$(DE,7))THENPRINT"NOT ENOUGH M
ONEY":GOTO250
620 IFB$=CN$(DE,3)THENCN$(DE,5)
="1":WE=WE-VAL(CN$(DE,4))
630 IFB$=CN$(DE,6)THENCN$(DE,8)
="1":WE=WE-VAL(CN$(DE,7))
640 PRINT"YOU HAVE";:PRINTUSINGW
$;WE
650 GOTO250
660 END
670 CA=RND(-TIMER):CA=RND(10)
680 IFCA=1THENLO=RND(10)*10:PRIN
T"YOU'RE ATTACKED BY PIRATES DUR
ING THE VOYAGE. THEY STEAL SOM
E OF YOUR MONEY.":WE=WE-LO:FORDL
=1TO4000:NEXTDL:RETURN
690 IFCA=2THENLO=RND(10)*10:PRIN
T"A BAD STORM! SEA WATER DAMAGES
YOUR CARGO. YOU'VE LOST $";LO;
"IN MERCHANDISE.":WE=WE-LO:FORDL
=1TO4000:NEXTDL:RETURN
700 RETURN
710 *****INV*****
720 FORD=1TO10:IFCN$(D,5)="1"THE
NPRINT CN$(D,3)
730 NEXTD
740 FORD=1TO10:IFCN$(D,8)="1"THE
NPRINTCN$(D,6)
750 NEXT D
760 GOTO250

```



# A PEACE TREATY FOR COMPUTER HACKERS AND COUCH POTATOES

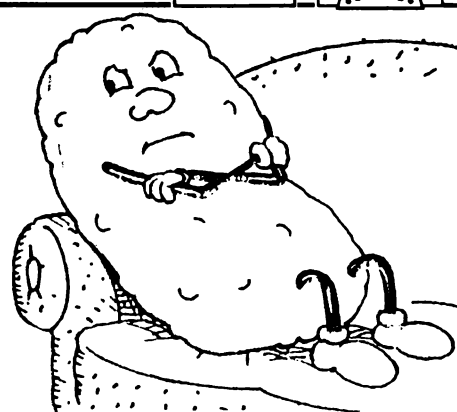
by Bill Bernico

What's the matter? Is your family on your case because your computer's always hooked up to the television and they can't watch their favourite shows? Now you can "solve" that problem with TV Shows (provided they haven't already disconnected you from the tube.)

Actually "solve" is not quite accurate. Though this program doesn't truly solve that very real dilemma, it does offer a tongue-in-cheek response to it by using the CoCo's sound and graphics capabilities.

Upon running the program you'll see a familiar sight - a television set. Along the left side of the screen you are presented with a list of nine choices. The last seven are things to watch on the TV and the first two are options that allow you to either turn the television on or off. Your choice is selected by using the up and down arrows. When you have chosen your option, press ENTER.

What! You selected a television show but nothing happened? Did you remember to turn the set on? Just as in real life, you can't watch anything until you first turn on the TV. Move the arrow to the top and press ENTER. Now the set's on and you can go ahead and select a program.



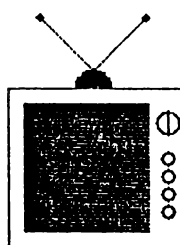
When you're finished watching television, don't forget to turn it off again. You can do this by moving the arrow up to the second option and pressing ENTER. Once the set is turned off, trying to select anything else is useless; the set has to be on first.

## Sample Printouts

### TU SHOWS

→ TURN ON TV  
TURN OFF TV

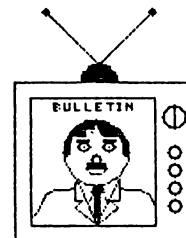
NETWORK NEWS  
CAR CARE SHOW  
WESTERN MOVIE  
THE LOVE BOAT  
MUSIC TELEVISION  
COPS AND ROBBERS  
THREE STOOGES



### TU SHOWS

→ TURN ON TV  
TURN OFF TV

NETWORK NEWS  
CAR CARE SHOW  
WESTERN MOVIE  
THE LOVE BOAT  
MUSIC TELEVISION  
COPS AND ROBBERS  
THREE STOOGES



240 .....22 680 .....83  
410 .....117 730 .....163  
530 .....112 770 .....21  
640 .....205 END .....153

Corrections  
ASAP

### The listing: TV SHOWS

```
10 'TELEVISION SHOWS
20 'BY BILL BERNICO
30 '708 MICHIGAN AVE.
40 'SHEBOYGAN, WI 53081
50 '(414) 459-7350
60 '
70 CLEAR 500
80 SP$="BR6
90 PD$="BR3R
100 WA$="F2R2E2UDF2R2E2UDF2R2E2U
DF2R2E2UDF2R2E2UDF2R2E2UDF2R2E2U
DF2R2E2UDF2R2E2UDF2R2E2UDF2R2E2U
DF
110 N1$="BR3NU4
120 N3$="BR3R3U2NL2U2NL3BD4
130 A$="BR3U3ERFDNL3D2
140 B$="BR3U4R2FGL2FGL2BR3
```

```
150 C$="BR4REGLHU2ERFBD3
160 D$="BR3U4R2FD2GL2BR3
170 E$="BR3NR3U2NR2U2R3BD4
180 F$="BR3U2NR2U2R3BD4
190 G$="BR3BU4BR3L2GD2FREULBR2BD
2
200 H$="BR3U4D2R3U2D4
210 I$="BR3R2LU4NLRBD4
220 J$="BR3BUFREU3LR2BD4
230 K$="BR3U2RNF2NE2LU2BR3BD4
240 L$="BR3NR3U4BR3BD4
250 M$="BR3U4FRED4
260 N$="BR3U4F3DNU4
270 O$="BR3BU2ERFD2GLNHBR
280 P$="BR3U4R2FGL2BR2BD2
290 Q$="BR3BU2ERFD2GNUNRLHBR3BD
300 R$="BR3U4R2FGL2RF2
310 S$="BR3R2EHLHER2BD4
320 T$="BR3BU4R4L2D4BR
330 U$="BR3NU4R3NU4
340 V$="BR3BU4D3FRENU3BD
350 W$="BR3NU4ERFNU4
360 X$="BR3UE2UDGHUFD2D
370 Y$="BR3BU4DFEUDGD2BR
380 PMODE4,1:PCLS1:SCREEN1,1:COL
OR,1:DRAW"S4BM130,170C0U90R100D
90L100BE9U72R70D72L70":PAINT(142
,91),0,0:CIRCLE(220,100),7:FOR X
=120 TO 150 STEP10:CIRCLE(220,X)
,4:NEXT:CIRCLE(178,80),11,0,1,.5
,1:DRAW"BM178,70NH30E30BM220,100
```

```
U7D14":CIRCLE(148,40),2
390 CIRCLE(208,40),2:PAINT(178,7
7),0,0:DRAW"BM10,9S8"+T$+V$+SP$+
S$+H$+O$+W$+S$:DRAW"BM10,11R50
400 DRAW"S4":LINE(17,39)-(90,31)
,PSET,B:PAINT(18,36),0,0:DRAW"BM
16,37C1"+T$+U$+R$+N$+SP$+O$+N$+S
P$+T$+V$:DRAW"C0":LINE(17,54)-(9
0,46),PSET,B:PAINT(18,51),0,0:DR
AW"BM16,52C1"+T$+U$+R$+N$+SP$+O$
+T$+F$+SP$+T$+V$
410 DRAW"S4BM15,68C0"+N$+E$+T$+W
$+O$+R$+K$+SP$+N$+E$+W$+S$:DRAW
"BM15,83"+C$+A$+R$+SP$+C$+A$+R$+E
$+SP$+S$+H$+O$+W$:DRAW"BM15,98"+
W$+E$+S$+T$+E$+R$+N$+SP$+M$+O$+V
$+I$+E$:DRAW"BM15,113"+T$+H$+E$+
SP$+L$+O$+V$+E$+SP$+B$+O$+A$+T$
420 DRAW"BM15,128"+M$+U$+S$+I$+C
$+SP$+T$+E$+L$+E$+V$+I$+S$+I$+O$
+N$:DRAW"BM15,143"+C$+O$+P$+S$+S
P$+A$+N$+D$+SP$+R$+O$+B$+E$+R
$+S$:DRAW"BM15,158"+T$+H$+R$+E$+
E$+SP$+S$+T$+O$+O$+G$+E$+S$
430 H=0:V=96:ZZ=0
440 BB$="R10NH3G3
450 DRAW"C0BM=H;=V;"+BB$
460 II$=INKEY$
470 IF II$=CHR$(94)THEN DRAW"C1B
M=H;=V;"+BB$:SOUND 210,1:V=V-15
480 IF II$=CHR$(10)THEN DRAW"C1B
```

```

M=H;=V;" +BB$:SOUND 210,1:V=V+15
490 IF II$=CHR$(13) AND V=36 AND
ZZ=0 THEN 820
500 IF II$=CHR$(13) AND V=51 AND
ZZ=1 THEN 810
510 IF II$=CHR$(13) AND V=66 AND
ZZ=1 THEN 610
520 IF II$=CHR$(13) AND V=81 AND
ZZ=1 THEN 660
530 IF II$=CHR$(13) AND V=96 AND
ZZ=1 THEN 680
540 IF II$=CHR$(13) AND V=111 AND
ZZ=1 THEN 700
550 IF II$=CHR$(13) AND V=126 AND
ZZ=1 THEN 710
560 IF II$=CHR$(13) AND V=141 AND
ZZ=1 THEN 730
570 IF II$=CHR$(13) AND V=156 AND
ZZ=1 THEN 750
580 IF V>156 THEN V=156
590 IF V<36 THEN V=36
600 GOTO 450
610 GOSUB 830: DRAW"C0":CIRCLE(17
6,120),19:CIRCLE(176,124),3
620 CIRCLE(169,117),4,0,.9:CIRCL
E(183,117),4,0,.9: DRAW"BM171,126
R10DL10DRI0DL10BM165,114R7UL7BR1
5R7DL7BM170,129F3R6E3BM176,102D3
FDFDRDRDR8F2DFD6FRBM176,104DGDGD
LDLDL8G2DGD6GLBM166,135DGDGDLGL9
GLGLDGDGDGDGDG3BM187,135FDFDFR
R9FRFRFDFDFDFBM165,135
630 DRAW"BM176,160BM189,135D12L5F4
M176,161LBM164,137D10R4G4M176,16
0":CIRCLE(177,142),4:PAINT(177,1
42),0,0: DRAW"BM177,139DF2DF2DF2B
M177,139DGD2DGD2DGD2BM175,142D14RU1
4RD15RU14":PAINT(177,103),0,0:PA
INT(175,103),0,0:PSET(169,117):P
SET(183,117)
640 DRAW"BM149,96"+B$+U$+L$+L$+E
$+T$+I$+N$:FOR X=1 TO 2000:NEXT:
GOSUB830: DRAW"BM142,96"+N$+E$+W$
+S$+SP$+F$+L$+A$+S$+H$: DRAW"BM15
0,124"+R$+A$+I$+N$+B$+O$+W$: DRAW
"BM150,132"+M$+A$+G$+A$+Z$+I$+N$
+E$: DRAW"BM141,140"+N$+A$+M$+E$+
D$+SP$+N$+O$+PD$+SP$+N1$
650 DRAW"BM155,148"+A$+G$+A$+I$+
N$+PD$:FOR X=1 TO 3:QZ$="1;2;3;4
;5;6;7;8;9;10;11;12;":PLAY"TG05L

```

```

24V15;":PLAY QZ$:NEXT:GOTO 450
660 GOSUB 830: DRAW"BM143,100"+C$
+A$+R$+SP$+C$+L$+I$+N$+I$+C$:DRA
W"BM141,140R68":CIRCLE(157,135),
5:CIRCLE(192,135),5:CIRCLE(157,1
35),1:CIRCLE(192,135),1: DRAW"BM1
62,136R25BM147,136NR3U20R30F7R18
D12L3BM150,118ND6R17D6L17R9U6BR1
1ND6R5F6ND12L11D12
670 FOR X=1 TO 1500:NEXT:EXEC 43
345: DRAW"BM184,123E13":FOR K=20
TO 45 STEP.2:POKE 140,RND(40)+K:
EXEC 43345:NEXT:GOTO 450
680 GOSUB 830: DRAW"BM141,120M158
,110ND2M164,104D6M171,116D2M178,
132D2GDGLGHNH5LGL2HLHUHULHLHL2
HL2HUHU2HU2BM141,146E15":CIRCLE(
167,120),2:CIRCLE(175,133),2:DRA
W"BM142,120ND10BR3BU2ND10BR3BU2N
D10BR3BU2ND10BR3BU2ND10BR3BU2D10
BM179,134R30BL48L8
690 DRAW"BM186,134E12G3H3F12BM19
3,134UERFDBM186,134BE9BU4H2U2E4U
2H4U2E4U2":FOR X=1 TO 2:PLAY"O4T
4L9CP8L12CCP8L12CCP8L12CGP8L12EG
P8L12EGP8L12E":NEXT:PLAY"L3C":GO
TO 450
700 GOSUB 830: DRAW"BM147,100"+L$
+O$+V$+E$+SP$+B$+O$+A$+T$: DRAW"B
M148,128NR48R8E3NR26E6R4G2R22G3N
D3E3L4E7L5G7L5E7L5G7R19G3D3R12D7
L44H5BM140,134"+WA$:GOTO 450
710 GOSUB 830: DRAW"BM145,125C0U3
0R10F15E15R10D30L12U18G13H13D18L
12BM187,116E8G4FRFRFRFRFBM198,
107FRFRFRFU10BM140,140R68BD3L68B
D3R68BD3L68BD3R68":CIRCLE(150,14
2),2:CIRCLE(158,149),2:CIRCLE(16
6,152),2:CIRCLE(174,146),2: DRAW"
BM151,142U8BM159,149U8
720 DRAW"BM167,152U8BM175,146U8B
M180,140D12":CIRCLE(187,150),2:C
IRCLE(195,155),2:CIRCLE(203,145)
,2: DRAW"BM188,150U8BM196,155U8BM
204,155U8":PLAY"V15T8L4O3CEGO4CP
4O3GO4L3C":GOTO 450
730 GOSUB830: DRAW"BM150,100C0"+D
$+R$+A$+G$+N$+E$+T$: DRAW"BM172,1
10M176,117M185,117M177,122M180,1
29M172,126M165,129M168,122M161,1
17M169,117M172,110BM149,150"+S$+

```

```

T$+A$+R$+S$+I$+N$+G$: DRAW"BM145,
157"+J$+A$+C$+K$+S$+W$+E$+B$+B$
740 CIRCLE(172,120),13: SOUND 1,1
2: SOUND 34,4: SOUND 44,2:FOR X=1
TO 340:NEXT: SOUND 1,9:FOR X=1 TO
700:NEXT: SOUND 1,12: SOUND 34,4:
SOUND 44,2:FOR X=1 TO 340:NEXT:S
OUND 1,9: SOUND 79,12:GOTO 450
750 GOSUB 830: DRAW"BM145,100C0"+
N3$+SP$+S$+T$+O$+G$+E$+S$: CIR
CLE(153,130),10:CIRCLE(175,130),
10:CIRCLE(197,130),10: DRAW"BM145
,128R16":PAINT(146,126),0,0: CIRC
LE(167,128),2:CIRCLE(168,125),2:
CIRCLE(169,122),2:CIRCLE(183,128
),2:CIRCLE(182,125),2
760 CIRCLE(181,122),2:PSET(153,1
33):PSET(175,133):PSET(197,133):
PSET(149,129):PSET(157,129):PSET
(171,129):PSET(179,129):PSET(193
,129):PSET(201,129): DRAW"BM140,1
42E6BR13F3ND21E3BR16F4ND21E4BR15
F3BM147,155"+M$: DRAW"BM172,155"+
L$: DRAW"BM195,155"+C$
770 DRAW"BM150,136R6BR16R6BR16R6
780 SOUND 125,6: SOUND 133,2: SOUN
D 146,12: SOUND 146,4: SOUND 170,8
: SOUND 159,6: SOUND 146,2: SOUND 1
46,4: SOUND 175,5:FOR X=1 TO 350:
NEXT X: SOUND 159,6: SOUND 146,2: S
OUND 146,4: SOUND 170,5:FOR X=1 T
O 350:NEXT X: SOUND 159,6: SOUND 1
46,2: SOUND 146,4
790 SOUND 175,5:FOR X=1 TO 350:N
EXT X: SOUND 125,6: SOUND 133,2: SO
UND 146,12: SOUND 146,4: SOUND 170
,8: SOUND 159,6: SOUND 146,2: SOUN
D 146,4: SOUND 175,5:FOR X=1 TO 52
5:NEXT X:PLAY"O3T2V25L8EFAAAGFD
":SOUND 89,3: SOUND 109,3: SOUND 1
25,3: SOUND 109,3
800 FOR X=1 TO 120:NEXT X: SOUND
125,3: SOUND 89,3:FOR X=1 TO 200:
NEXT X: SOUND 175,2:GOTO 450
810 GOSUB 830: PAINT(142,91),0,0:
ZZ=0:GOTO 450
820 GOSUB 830:GOTO 450
830 LINE(140,90)-(208,160),PRESE
T,BF:ZZ=1:RETURN

```

## CoCocad Modification

"CoCocad: The Schematic Scoundrel" (October 1985, Page 130): Peter Kerckhoff writes to tell us that some other printers besides the Gemini-10X can be used with this program.

First of all, there is a rather roundabout method that works with any printer that can be used to make screen dumps of regular CoCo graphics, if you have a screen dump program for your printer. Delete Line 1990 from the main program. When you request a printout, *CoCocad* will now save nine screen files on the disk. Each has the name

*PRT.PGn*; 'n' is the page number (so *PRT.PG3* would be the third page).

Now load in your screen print program and type the command *PMODE 4,1:SCREEN1,1* and press ENTER. Then, for each file type *LOADM"PRT.PGn"*, and after the file is loaded activate the screen print routine. Once you have printed all nine pictures, cut them out and tape them together.

Peter also included a new version of the *Cadprint* printer driver that is designed for the Tandy/Radio Shack DMP series printers. Here it is:

### The listing: CADPRINT

```

10 'CADPRINT VR1.0 BY P.KERCKHOF
F 4335 HENDRIX WAY SAN JOSE CA -
1985 RAINBOW MAG (OCT)
20 'MODIFIED FOR USE WITH RADIO
SHACK DMP-120 PRINTER BY DAVISSO
N ON 10/15/85
30 CLEAR100,0,H379A:CLS:PRINT"cad
print RUNNING":FORX=H379B TO H3
37FA:READ A:POKEX,A:NEXTX
40 POKE150,41 '1200 BAUD
50 PRINT#-2,CHR$(18)
60 FOR PG=0TO8STEP3

```

```

70 LOADM"PRT.PG"+RIGHT$(STR$(PG
),1),H2A00
80 LOADM"PRT.PG"+RIGHT$(STR$(PG+
1),1),H4200
90 LOADM"PRT.PG"+RIGHT$(STR$(PG+
2),1),H5A00
100 EXEC H379B
110 KILL"PRT.PG"+RIGHT$(STR$(PG
),1):KILL"PRT.PG"+RIGHT$(STR$(PG+
1),1):KILL"PRT.PG"+RIGHT$(STR$(P
G+2),1):NEXT PG
120 PRINT:PRINT"DONE.":PRINT#-2,

```

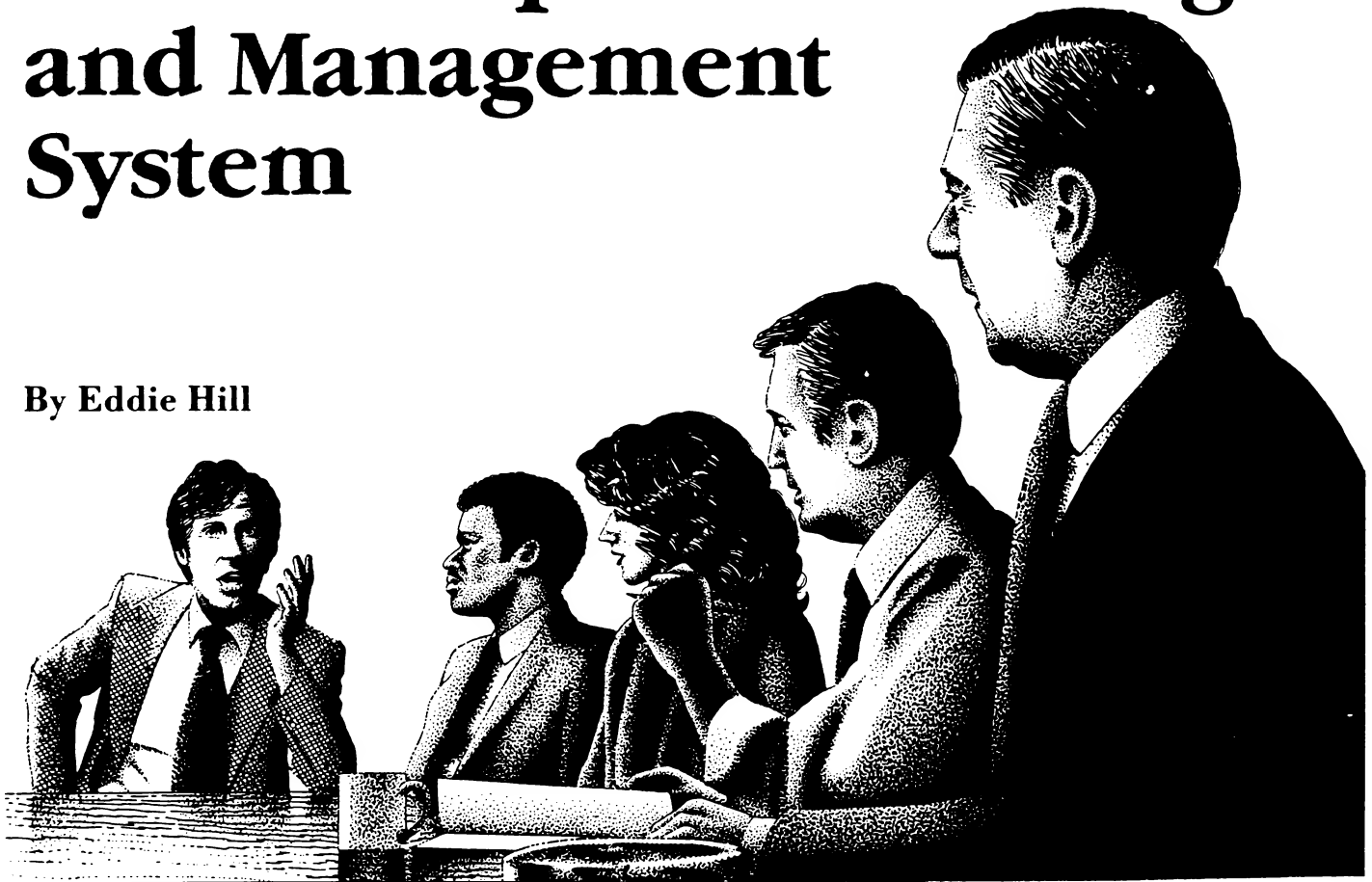
```

CHR$(30):STOP
130 DATA 134,254,151,111,134,1,1
42,126,224,48,134,52,2,141,38,53
,2,142,102,224,48,134,52,2,141,2
7,53,2,142,78,224,48,134,52,2,14
1,16,134,13,173,159,160,2,53,2,7
6,129,31,38,212,15,111,57
140 DATA 198,156,52,200,230,132,1
6,142,0,8,16,191,55,249,88,70,12
2,55,250,16,190,55,249,38,245,67
,138,128,173,159,160,2,53,200,48,
136,224,90,38,218,57,0,0

```

# Annual Expense Tracking and Management System

By Eddie Hill



**T**his system (set of three programs) allows an individual, or possibly a small business, to maintain and track expenses for one year. A maximum of 135 transactions per month for up to 100 account codes may be tracked by month for an entire year (12 month period). Each expense you wish to track must have a numeric code in the range of 1 through 100 with a description not exceeding 27 characters. The system provides for screen display and printing of data and reports and is designed for use on a 64K CoCo with one disk drive and a DMP-100 printer. In addition to maintaining actual transaction data, the system provides budgetary analysis for accounts over the year. This feature allows for comparative analysis of actual versus budget for an account (display and printout). It should be noted that budget or transaction summary amounts for an account cannot exceed \$99,999.99 and a detailed transaction entry for an account cannot be greater than \$9,999.99.

Before proceeding, a discussion of a few basic concepts employed in the design of the system and programs is warranted. The programs feature extensive use of arrays which facilitate fast display of data and fast data entry and maintenance. The disk file access methods are extremely simple and straightforward and, for the most part, use array concepts. This extensive utilization of arrays in the programs yields a system which is both efficient and

inefficient, but overall it provides an effective and simple-to-use-and-understand method for tracking expenses.

The design of the system requires that an entire diskette be dedicated for the recording of budgeted and actual expenditures for a year. If you utilize diskette backup for your files and system programs, then two diskettes will be required for one year of data (assuming you have only one backup diskette). Although the system can be used without a printer, one is highly recommended to achieve best results.

As mentioned previously, the system consists of three programs. One program (*Crexpfle*) creates the basic files required for system utilization. The system will not run until this program has been successfully executed. The second program (*Exptrakr*) allows the entry and maintenance of all budget and actual data. It also permits various screen displays of the data (both budget and actual). The third program (*Reptgenr*) prints various listings of budget and actual data. Execution of this program can be independent of *Exptrakr* or may be selected from the main menu of *Exptrakr*. After execution of *Reptgenr* you may return to *Exptrakr* by exercising the appropriate selection option from the main menu of *Reptgenr*. You may freely transfer between *Exptrakr* and *Reptgenr* or run either as a stand-alone program. It is important that you name the programs "*Exptrakr*" and "*Reptgenr*" because these are the names used in the call routines for the programs.

Both *Exptrakr* and *Reptgenr* are menu driven programs

**Exhibit 1****MONTHLY TRANSACTIONS FOR JANUARY 1986**

REC NUM	ACT NUM	.....ACCOUNT DESCRIPTION.....	TRAN I.D.	DA	..AMOUNT..	TRANS. DESCRIPTION
1	1	HOUSE MORTGAGE	100	31	200.00	PAYMENT
2	2	INSURANCE	50	31	100.00	PREMIUM
3	3	BANK CARDS	125	31	150.00	PAYMENT
4	4	ELECTRICITY	150	31	125.00	BILL
5	5	AUTO PAYMENT	110	31	180.00	PAYMENT #10
6	6	GROCERIES	90	15	175.00	W.D.
7	7	CLOTHING	95	25	80.00	JIM'S
8	8	MISCELLANEOUS	98	28	75.00	SOFTWARE
9	6	GROCERIES	99	31	245.00	J&D GROCERY
10	7	CLOTHING	134	31	30.00	SHOES
TOTAL----->					\$ 1,360.00	

with submenus, instructions and comments as required. This approach offers easy access to (and exits from) routines within the programs. As with all BASIC programs, if you wish to exit a routine before completion, you may hit the BREAK key. Use extreme caution when exercising this option. An entire file or files can be easily "garbaged." Therefore, it is not recommended. You may want to consider a BREAK disable routine in the programs.

**Crexpfile**

*Crexpfile* creates the basic files for the system. It merely formats and sizes the following files:

- Budget Summary
- Transaction Summary
- Chart of Accounts
- Detail Transaction Filenames

It must be executed before attempting to run *Exptrakr* or *Reptgenr*.

**Exptrakr**

This program is the heart of the system. It allows for entry and maintenance of all data utilized by the system. This includes charts of accounts, budget and transaction data. *Exptrakr* opens up with a main menu consisting of 14 options. The main menu appears as shown below.

- 1) Add/change/input budget
- 2) Account YTD summary trans.
- 3) Account actual vs. budget
- 4) Account budget for year
- 5) Chart of accounts maint.
- 6) Display chart of accounts
- 7) Add/chg/del/input trans.
- 8) Display monthly budget
- 9) Display monthly trans.
- 10) Display actual vs. budget
- 11) Report generator
- 12) File deletion
- 13) Backup files
- 14) End session

A discussion of each option follows.

**1) Add/Change/Input Budget**

Allows input and maintenance of budget data for an account. You select the month you wish to enter or change by entering the appropriate number for the month (1-12).

If you wish to enter or change data for all months, enter "99." You return to the main menu by entering '0'.

**2) Account YTD Summary Transaction**

A display of a specified account showing summary amounts by month. Pressing ENTER returns you to the main menu.

**3) Account Actual vs. Budget**

Permits display of summarized actual versus budget amounts for a month or year-to-date through a given month.

**4) Account Budget For Year**

Displays the yearly budget month by month for an account.

**5) Chart of Accounts Maintenance**

As stated earlier, each expense you wish to track must have a numeric code in the range 1 through 100 and a description not exceeding 27 characters. The first five positions of the description cannot be "XXXXX" since this denotes to the system that the account has not been established for use. If you inadvertently enter a description with more than 27 characters or "XXXXX" in the first five positions, the system will prompt you to re-enter the description.

This selection gives you three options as follows:

**Option 1 —** Allows for the entry of account descriptions in numeric order. You are first prompted for the description of Account 1, then Account 2 and so forth until you have entered descriptions for all 100 accounts. If you wish to terminate entry of descriptions at any point before Account 100, merely type THATS ALL and press ENTER. The system will automatically return to the main menu just as it does when the description for Account 100 has been entered.

**Option 2 —** Allows for the addition or changing of account descriptions. The same procedure is used to add

**Exhibit 2****BUDGET FOR JANUARY 1986**

ACT	<---D E S C R I P T I O N-->	..AMOUNT..
1	HOUSE MORTGAGE	200.00
2	INSURANCE	50.00
3	BANK CARDS	100.00
4	ELECTRICITY	150.00
5	AUTO PAYMENT	180.00
6	GROCERIES	400.00
7	CLOTHING	100.00
8	MISCELLANEOUS	50.00
TOTAL		1,230.00



or change an account description. A prompt appears that asks for the account number. After entering a valid account number the account number and description will be displayed. You will be asked if this is the account you wish to add or change. If so, type YES and press ENTER. If not, type NO and ENTER. After entering a changed or added account description you will be asked if you wish to add or change any more account descriptions. The process will repeat as long as you respond "yes." A "no" response will return you to the main menu.

Option 3 — Choosing this option will return you to the main menu.

#### 6) Display Chart of Accounts

Allows for the display of all account numbers with their descriptions (Option 1) or for a single account number with its description (Option 2). If an account description is all X's, it has not been set up for use by the system. Option 3 returns you to the main menu.

#### 7) Add/Chg/Del/ Input Transaction

Permits the entry and maintenance of detail transactions (expenses) for a selected month.

Option 1 — This allows the entry of detail expenses for a selected month. You are asked for the number of the month (1-12). The program then checks to see if transactions have already been entered for the month selected. If so, you cannot re-enter the transactions unless

you delete the entire month's transaction file (see Selection 12, File deletion, for instructions). If transactions for the month you wish to enter are not on file, the program allows you to continue and prompts you through entry of your expenses. Please notice the program assigns each entry a record number which will be used for changing or deleting transactions, if necessary, in the future. Each addition to a month's transaction must be assigned a record number. This must be an unused number in the range 1-100. More on changes, deletions and additions later.

The entry of detail transactions requires a valid account number for each transaction. Therefore, you must set your chart of accounts file up prior to using this option. Other information you must enter is as follows:

Date — This is the day the transaction occurred.

Trans. I.D. — A one- to four-digit identifying tag (e.g., check number). May be alphabetic or numeric.

Amount — The amount of the transaction (not to exceed \$9,999.99) may be debit or credit.

Description — This is an optional identification, not exceeding 14 characters, for the transaction (e.g., monthly payment).

When the entry of the detail transaction is complete, press ENTER. This writes the transaction to the file and returns to a fresh transaction entry screen for input of the next transaction. Upon completing the entry of all detail transactions for the month, enter "ZZZ" in the

Exhibit 3

BUDGET FOR 1986		JAN MAY SEP	FEB JUN OCT	MAR JUL NOV	APR AUG DEC
HOUSE MORTGAGE		200.00	200.00	200.00	200.00
		200.00	200.00	200.00	200.00
1 TOTAL..\$	2,400.00	200.00	200.00	200.00	200.00
INSURANCE		50.00	50.00	50.00	50.00
		50.00	50.00	50.00	50.00
2 TOTAL..\$	600.00	50.00	50.00	50.00	50.00
BANK CARDS		100.00	100.00	100.00	100.00
		100.00	100.00	100.00	100.00
3 TOTAL..\$	1,200.00	100.00	100.00	100.00	100.00
ELECTRICITY		150.00	150.00	150.00	150.00
		150.00	150.00	150.00	150.00
4 TOTAL..\$	1,800.00	150.00	150.00	150.00	150.00
AUTO PAYMENT		180.00	180.00	180.00	180.00
		180.00	180.00	180.00	180.00
5 TOTAL..\$	2,160.00	180.00	180.00	180.00	180.00
GROCERIES		400.00	400.00	400.00	400.00
		400.00	400.00	400.00	400.00
6 TOTAL..\$	4,800.00	400.00	400.00	400.00	400.00
CLOTHING		100.00	100.00	100.00	100.00
		100.00	100.00	100.00	100.00
7 TOTAL..\$	1,200.00	100.00	100.00	100.00	100.00
MISCELLANEOUS		50.00	50.00	50.00	50.00
		50.00	50.00	50.00	50.00
8 TOTAL..\$	600.00	50.00	50.00	50.00	50.00
TOTAL BUDGET FOR YEAR		1,230.00	1,230.00	1,230.00	1,230.00
		1,230.00	1,230.00	1,230.00	1,230.00
999 TOTAL..\$	14,760.00	1,230.00	1,230.00	1,230.00	1,230.00

# Exhibit 4

ACTUAL FOR 1986		JAN MAY SEP	FEB JUN OCT	MAR JUL NOV	APR AUG DEC
HOUSE MORTGAGE		200.00	0.00	0.00	0.00
1	TOTAL..\$ 200.00	0.00	0.00	0.00	0.00
INSURANCE		100.00	0.00	0.00	0.00
2	TOTAL..\$ 100.00	0.00	0.00	0.00	0.00
BANK CARDS		150.00	0.00	0.00	0.00
3	TOTAL..\$ 150.00	0.00	0.00	0.00	0.00
ELECTRICITY		125.00	0.00	0.00	0.00
4	TOTAL..\$ 125.00	0.00	0.00	0.00	0.00
AUTO PAYMENT		180.00	0.00	0.00	0.00
5	TOTAL..\$ 180.00	0.00	0.00	0.00	0.00
GROCERIES		420.00	0.00	0.00	0.00
6	TOTAL..\$ 420.00	0.00	0.00	0.00	0.00
CLOTHING		110.00	0.00	0.00	0.00
7	TOTAL..\$ 110.00	0.00	0.00	0.00	0.00
MISCELLANEOUS		75.00	0.00	0.00	0.00
8	TOTAL..\$ 75.00	0.00	0.00	0.00	0.00
TOTAL ACTUAL FOR YEAR		1,360.00	0.00	0.00	0.00
999	TOTAL..\$ 1,360.00	0.00	0.00	0.00	0.00

account number field and press ENTER. This will complete the writing of the transaction file and post transaction summary totals for the month. After this is complete you are returned to the data entry submenu.

Option 2 — Allows the entering of new information for a transaction which has already been entered. You must specify the month and the record number of the transaction (shown on detail printout of month's transactions) you wish to change. A check is made to ensure that you have entered a correct record number. If the record number is valid, the transaction is displayed. Next, you are asked if it is the one you wish to change. If so, all

of the data must be re-entered for the transaction (just as if it were new). Upon completion of entry of the new data for the transaction, press ENTER. This records the transaction on the file and asks if you wish to change more transactions. If you answer 'Y' then the process repeats, else the transaction summary file is updated and you are returned to the data entry submenu.

Option 3 — This option will add new transactions (e.g., overlooked, not available at time data for month was entered) to a month's file. You must specify the record number for the record to be added. This may be derived by looking at a detail printout for the month and adding one to the record number shown for the last transaction. The program will not permit the addition of a transaction with an existing record number, as it checks this before allowing you to proceed. Once it is determined that you are not trying to add a duplicate record, you are presented with the data entry screen. The procedure from this point is the same as for entering change data in Option 2 of this selection. Instead of referring to transaction changes, the prompts relate to transaction additions.

Option 4 — Allows you to delete a transaction from a month's file (e.g., a transaction was included in the wrong month). Again you must work with a record number,

## Exhibit 5

TRANSACTION SUMMARY FOR 1986 ....A/0 01/31/86

ACT ....ACCOUNT DESCRIPTION.... ...AMOUNT...

1	HOUSE MORTGAGE	200.00
2	INSURANCE	100.00
3	BANK CARDS	150.00
4	ELECTRICITY	125.00
5	AUTO PAYMENT	180.00
6	GROCERIES	420.00
7	CLOTHING	110.00
8	MISCELLANEOUS	75.00

TOTAL \$ 1,360.00

**Exhibit 6****ACTUAL VS. BUDGET FOR JANUARY 1986**

ACT	...D E S C R I P T I O N...	...ACTUAL..	...BUDGET..	..VARIANCE.
1	HOUSE MORTGAGE	200.00	200.00	0.00
2	INSURANCE	100.00	50.00	50.00-
3	BANK CARDS	150.00	100.00	50.00-
4	ELECTRICITY	125.00	150.00	25.00
5	AUTO PAYMENT	180.00	180.00	0.00
6	GROCERIES	420.00	400.00	20.00-
7	CLOTHING	110.00	100.00	10.00-
8	MISCELLANEOUS	75.00	50.00	25.00-
TOTAL ---->		\$ 1,360.00	\$ 1,230.00	\$ 130.00-

**Exhibit 7****YEAR TO DATE A/O JANUARY 1986**

ACT	...D E S C R I P T I O N...	...ACTUAL..	...BUDGET..	..VARIANCE.
1	HOUSE MORTGAGE	200.00	200.00	0.00
2	INSURANCE	100.00	50.00	50.00-
3	BANK CARDS	150.00	100.00	50.00-
4	ELECTRICITY	125.00	150.00	25.00
5	AUTO PAYMENT	180.00	180.00	0.00
6	GROCERIES	420.00	400.00	20.00-
7	CLOTHING	110.00	100.00	10.00-
8	MISCELLANEOUS	75.00	50.00	25.00-
TOTAL ---->		\$ 1,360.00	\$ 1,230.00	\$ 130.00-

which may be obtained from the printout of the detail transactions for the month. You are asked for the deletion record number, then the program checks to see if it is valid. If so, it displays the record for a visual verification. You are asked if this is the record you wish to delete. A response of 'N' prompts you for another record number while a 'Y' response deletes the record and updates the appropriate files. The steps from this point follow the same logic as options 2 and 3 in this selection, except comments that relate to deletions.

Option 5 — Returns to the main menu. It should be noted that options 1 through 4 for this selection allow for submenu return in case you chose an option in error.

**8) Display Monthly Budget**

Displays budgeted account expenditures for a selected month.

**9) Display Monthly Transaction**

Displays the summary amount of each account's transactions for a selected month.

**10) Display Actual vs. Budget**

You have the choice of choosing a specific month or year-to-date through a specific month. The submenu will guide you.

**11) Report Generator**

This selection allows you to print out reports from the data you have entered. This is a separate program (*Reptgenr*, program Listing 3) and is called from this menu choice. You are given seven print selections plus a selection to return to the main program (*Exptrkr*) or to terminate the session. Details on this selection are covered in the comments on program Listing 3.

**12) File Deletion**

This selection allows you to delete either a budget or transaction file for a specified month. The appropriate transactions summaries are adjusted. After completion of

this option, data for a given month (budget or transaction) may be re-entered.

**13) Backup Files**

The method used is the single disk copy procedure provided for but not documented in the Radio Shack manuals. I recommend at least a two-generation backup system (backup of current files, plus prior generation).

**14) End Session**

Choose this option when you are ready to end the program (*Exptrkr*). Remember to backup your files.

**Reptgenr**

This program provides for various listings of your data. A discussion of the selections follows:

**1) List Monthly Transactions**

This selection gives you a listing of all the transactions for a specified month. The listing is the only place where this detail is given. Record numbers are obtained from this listing. See Exhibit 1.

**2) List Monthly Budget**

This option provides a listing of the budget amounts for each account with budgeted expenditures in a specified month. See Exhibit 2.

**3) List Budget For Year**

Provides a month-by-month listing of each account's budgeted amounts for the year. See Exhibit 3.

**4) List Actual For Year**

Provides a month-by-month listing of each account's actual amounts for the year. See Exhibit 4.

**5) List Transaction Summary For Year**

Provides a summarized listing of all account amounts entered. See Exhibit 5.

continued on Page 28

# RECEIPT MAKER AND FILE

by Bill Tottingham

Once you've had the CoCo for a while, as most of you have probably experienced, you begin to look for ways to use it for about anything you can think of, if for no other reason than to prove your computer is more than "just a toy", as the guy down the street the the \$5000 IBM says. Any of us who have spent any time with the CoCo know that's a ridiculous notion. I know several people who run small volume businesses who would love to use the CoCo due to its relatively low cost. One particular person wanted a program that not only printed out a receipt (he was writing them out by hand), but also would save the information to disk for later tax purposes. This program is the result - no need for a million dollar computer and another million in software.

To use Receipt File you must have at least 32K and a disk, and should have a printer. The program is set to use a DMP-100 at 1200 Baud. If you are going to use a different printer, change the received control codes in the following lines:

## Entering Data

After making any needed changes, you are ready to run the program. The first thing you will see is the main menu. On it will be five choices (8see Ffigure 1). Since we're just getting started, press '2' for "Enter new data." You will then be asked the date. Enter it in the same format the example shows, then press ENTER. You will then be asked if the information given was correct. (When entering new data you will always be asked if the information provided was correct.)

Next you will be asked for a "Receipt number." *You must enter a number.* This is the number the program uses for filing. It also must be a number different from one already on file. The best bet is to give the receipt a number incremented by one over the preceding receipt. For the first one, enter 001.

You will now be asked to enter "Received of." Here you may enter the name of your customer.

Next comes the "Dollar amount paid." This is exactly what it says. Enter this like the example shows.

Now we come to "Amount of Account." This is the total purchase price. You can use the balance due from any previous payment of the same account. This will be printed on the receipt with the amount paid and a balance due. If the amount of account is the same as the amount paid, simply enter the amount paid here again if you wish. If not, press ENTER.

Finally we come to the comment line. Enter anything you wish; however, it is customary to use this for what was purchased, or the nature of the transaction. If you are the purchaser, you might want to enter the name of the other party, so if the hard copy is lost you will still have the information come tax time. There is a 30 character space here.

You now find yourself back at the main menu. If you want to examine the information to be printed and/or saved, press '3'. If any of the information is wrong, press 'M' to return to the main menu and press '2' to re-enter all the data. If everything is correct, the receipt can be printed or saved to disk. Press 'M' to get back to the menu.

## Saving to Disk

If you are planning to save this data on disk, it can be done now or after printing the receipt.

To save on disk, press '1' for the disk menu (Figure 2). Here again there will be five choices. Since we are saving data, press '3'. You will then be asked

Line	DMP-100	Function
830	POKE149,0:POKE150,41	1200 Baud printer
850	CHR\$(15)	Enable underline
860	CHR\$(14)	Disable underline
870	CHR\$(31)	Elongated mode
880	CHR\$(30)	Character mode



to press ENTER for save or 'M' for menu. After the save is completed, you will be returned to the main menu.

### Printing the Receipt

To print the receipt, press '4'. You will be asked if you want a copy. Pressing 'Y' tells the printer to print two receipts. Before answering this prompt make sure your printer is on and ready to go.

After printing, you will be returned to the main menu. Here you may save the data (if not previously saved), enter new data or look at and/or load previous accounts.

### Entering Data from Disk

To load data from disk, first get to the disk menu by pressing '1' on the main menu. The easiest way to load is to press '1' from the disk menu. A list of receipt numbers will appear on the screen preceded by a number; for example: 1) 001. To load receipt #001, press '1' and ENTER and the file will load. If you already know the receipt number, press '2' on the disk menu and enter the number at the prompt.

After loading, you will automatically be in the examine mode (Figure 3). From there you can print out a receipt, load a different receipt or enter new data.

As with all programs, this one can be modified to your specific needs. Some ideas might be to incorporate a different filing system if you are in a higher volume business. To enter data faster, you could hack off everything after the

line input statements in lines 240 through 270 and in Line 280 after the `BD$=STR$(BD)` statement. A line could also be added in the printer routine that would print a line under the receipt for written comments. ☐

Figure 1

```

MENU

[1]    DISK MENU
[2]    ENTER NEW DATA
[3]    EXAMINE
[4]    PRINT RECEIPT
[Q]    QUIT PROGRAM
  
```

Figure 2

### DISK MENU

```

[1]    DIRECTORY OF FILES
[2]    LOAD FROM DISK
[3]    SAVE TO DISK
[M]    MAIN MENU
[Q]    QUIT PROGRAM
  
```

Figure 3

```

#001                      6/25/86

JOHN Q. SMITH

AMT. OF ACCOUNT          $302.43
AMT. PAID                 $259.99
BALANCE DUE               $42.44

COMMENTS: PART # 35771

PRESS [M] FOR MENU
  
```

Figure 4

```

NO. 001                      Date 6/25/86

Received of JOHN Q. SMITH

$259.99 ***** DOLLARS
100

AMT. OF ACCOUNT          302.43
AMT. PAID                259.99
BALANCE DUE              42.44

CMTS: PART #35771
  
```

170 .....205  
290 .....20  
440 .....142  
610 .....183  
840 .....85  
1090 .....190  
END .....72

### The listing: RECEIPT

```

10 CLEAR
20 CLEAR5000
30 VERIFY ON
40 DIMP$(35,2)
50 CLS:PRINT@46,"MENU":PRINT@165
,"[1]    DISK MENU":PRINT@229,"
[2]    ENTER NEW DATA":PRINT@29
,"[3]    EXAMINE":PRINT@357,"[
4]    PRINT RECEIPT":PRINT@421,
"[Q]    QUIT PROGRAM"
60 AN$=INKEY$:IFAN$=""GOTO60
70 IFAN$="Q"GOTO130
80 IFAN$="1"GOTO140
90 IFAN$="2"GOTO220
100 IFAN$="3"GOTO520
110 IFAN$="4"GOTO760
120 GOTO60
130 GOSUB570:CLS:END
140 CLS:PRINT@44,"DISK MENU":PRI
NT@165,"[1]    DIRECTORY OF FIL
ES":PRINT@229,"[2]    LOAD FROM
DISK":PRINT@293,"[3]    SAVE T
  
```

```

O DISK":PRINT@357,"[M]    MAIN
MENU":PRINT@421,"[Q]    QUIT PR
OGRAM"
150 I$=INKEY$:IFI$=""GOTO150
160 IFI$="1"GOTO110
170 IFI$="2"GOTO450
180 IFI$="3"GOTO370
190 IFI$="M"GOTO50
200 IFI$="Q"GOTO130
210 GOTO150
220 'ENTER DATA ROUTINE
230 GOSUB570
240 CLS:PRINT@103,"ENTER RECEIPT
DATE":PRINT@136,"(EX. 6/25/85)"
:LINEINPUT"      ":D$:GOSUB
340:PRINT@320,"      "-D$"-":GOS
UB320:IFI$=""GOTO240
250 CLS:PRINT@103,"ENTER RECEIPT
#":PRINT@136,"(EX. 001)":LINEIN
PUT"      ":N$:GOSUB340:PRIN
T@320,"      "-N$"-":GOSUB320:IFI
$=""GOTO250
260 CLS:PRINT@103,"ENTER RECEIVE
D OF":PRINT@134,"(EX. JOHN Q. SM
ITH)":LINEINPUT"      ":RO$:GOSUB34
0:PRINT@320,"      "-RO$"-":GOSUB
320:IFI$=""THEN260
270 CLS:PRINT@100,"ENTER DOLLAR
AMOUNT PAID":PRINT@134,"(EX. 259
.99 OR 499)":LINEINPUT"
":DO$:DO=VAL(DO$):GOSUB340:PRINT
@322,"      "-":PRINTUSING"$$$###.###"
:DO$:PRINT"-":GOSUB320:IFI$=""T
HEN270
280 CLS:PRINT@99,"ENTER TOTAL AM
T. OF ACCOUNT":PRINT@135,"(EX. 3
02.43 OR 500)":LINEINPUT"
":TA$:TA=VAL(TA$):BD=(TA-DO)
:BD$=STR$(BD):GOSUB340:PRINT@323
,"      "-":PRINTUSING"$$$###.###":TA
$:PRINT"-":GOSUB320:IFI$=""THEN
280
290 CLS:PRINT@102,"ENTER COMMENT
LINE":PRINT@134,"(EX. PART #357
71)":PRINT@223,"]":PRINT@192,"[
":LINEINPUTC$
300 IFLEN(C$)>30GOTO360
310 GOSUB570:GOTO50
320 I$=INKEY$:IFI$=""THEN320
330 RETURN
340 PRINT@290,"YOU ENTERED-":PRI
NT@354,"IS THAT CORRECT? (Y/N)":
RETURN
350 GOTO50
360 CLS:PRINT@170,"LINE TO LONG"
:FOR T=1TO500:NEXTT:GOTO290
370 'DISK ROUTINE
380 BD$=STR$(BD)
390 CLS:PRINT@166,"HIT <ENTER> T
O SAVE":PRINT@232,"OR <M> FOR ME
NU"
400 I$=INKEY$:IFI$=""GOTO400
410 IFI$="M"GOTO50
420 IFI$="CHR$(13)GOTO440
430 GOTO400
440 GOSUB570:CLS:GOSUB580:GOSUB7
40:GOSUB570:GOTO50
450 CLS:PRINT@170,"ENTER FILE #"
:PRINT@330,"[M] FOR MENU"
460 PRINT@242,"]":PRINT@236,"[":
:LINEINPUTN$
470 Z=LEN(N$):IFZ>5GOTO450
480 IFN$="M"GOTO50
490 CLS:PRINT@168,"LOADING #":N$
  
```

```

:PRINT@182,STRING$(10,32)
500 GOSUB570:GOSUB580:GOSUB750:G
OSUB670
510 TA=VAL(TA$):DO=VAL(DO$):BD=V
AL(BD$)
520 BD=(TA-DO)
530 CLS:PRINT@1,"#";N$:PRINT@20,
D$:PRINT@67,RO$:PRINT@131,"AMT.
OF ACCOUNT ";:PRINTUSING"$$$###.
##";TA:PRINT@201,"AMT. PAID ";:
PRINTUSING"$$$###.##";DO:PRINT@26
3,"BALANCE DUE ";:PRINTUSING"$$$
###.##";BD:PRINT@323,"COMMENTS:
";C$
540 PRINT@458,"[M] FOR MENU"
550 I$=INKEY$:IFI$="M"GOTO500
560 GOTO550
570 CLOSE#1:RETURN
580 OPEN"D",#1,N$,110
590 FIELD#1,10 AS XTA$,10 AS XD
$,10 AS XDO$,10 AS XBD$,30 AS XR
O$,30 AS XC$,10 AS XDT$
600 LSET XTA$=TA$
610 LSET XDO$=DO$
620 LSET XBD$=BD$
630 LSET XRO$=RO$
640 LSET XCS=C$
650 LSET XDT$=D$
660 TA$=XTA$
670 D$=XDT$
680 DO$=XDO$
690 BD$=XBD$
700 RO$=XRO$
710 C$=XC$:RETURN
720 RETURN
730 PUT#1:RETURN
740 GET#1:RETURN
750 'PRINTER ROUTINE
760 CLS:PRINT@133,"DO YOU WANT A
COPY FOR":PRINT@165,"FOR YOUR R
ECORDS ALSO?":PRINT@205,"(Y/N)"
770 PC$=INKEY$:IFPC$=" "GOTO780
780 IF PC$="Y" THEN PC=2
790 IFPC$="Y"ORPC$="N"GOTO820
800 GOTO780
810 CLS:PRINT@236,"PRINTING"
820 POKE149,0:POKE150,41:'1200BA
UD
830 FORPP=1TOPC
840 US=CHR$(15):'UNDERLINING ON
850 DU$=CHR$(14):'LINING OFF
860 ES=CHR$(31):'DOUBLEWIDTH/ON
870 DES=CHR$(30):'D.W./OFF
880 NOS="NO":DT$="Date ":RC$="R
eceived of":DL$="DOLLARS"
890 AC$="AMT. OF ACCOUNT "
900 AP$=" AMT. PAID "
910 BD$=" BALANCE DUE "
920 LF$=STRING$(2,10):S$=CHR$(32
)
930 PRINT#-2,U$;STRING$(80,32);S
TRING$(2,10);DU$
940 PRINT#-2,E$;NOS;DES;U$;S$;N$
;S$;DU$;STRING$(46,32);E$;DT$;DE
S;U$;S$;D$;S$;DU$;LF$
950 LR=LEN(RO$):LS=(47-LR)
960 PRINT#-2,E$;RC$;DES;U$;S$;S$
;S$;S$;S$;RO$;STRING$(LS,32);DU$
;LF$
970 PRINT#-2,U$;STRING$(30,32);E
$;:PRINT#-2,USING"$$$###.##";DO::
PRINT#-2,DES;STRING$(11,42);DU$;
E$;DL$;DES
980 PRINT#-2,U$;STRING$(25,32);D
U$;STRING$(28,32);"1000"
990 PRINT#-2,AC$;:PRINT#-2,USIN
G"####.##";TA
1000 C=LEN(C$):CL=(32-C)
1010 PRINT#-2,AP$;U$;:PRINT#-2,U
SING"####.##";DO;:PRINT#-2,DU$;S
TRING$(15,32);"CMTS ";U$;C$;STR
ING$(CL,32);DU$
1020 PRINT#-2,U$;BD$;:PRINT#-2,U
SING"####.##";BD;:PRINT#-2,CHR$(
32)
1030 PRINT#-2,CHR$(10);DU$;STRIN
G$(43,32);E$;"$";DES;U$;STRING$(
32,32)
1040 PRINT#-2,U$;STRING$(80,32);

```

```

DU$
1060 PRINT#-2,STRING$(10,10)
1062 IFPC=2GOTO1065
1063 GOTO1070
1065 IFPP=1THENPRINT#-2,STRING$(
38,10)
1070 NEXTPP
1080 GOTO500
1090 CLS:END
1100 CLS:'DIRECTORY ROUTINE
1110 CLEAR
1120 GOSUB570
1130 FORZ=3TO11
1140 DSKI$0,17,Z,A$,B$
1150 X$=A$:GOSUB1190
1160 X$=B$:GOSUB1190
1170 NEXTZ
1180 GOTO1280
1190 FORJ=1TO128STEP32
1200 R=R+1
1210 P$(R,1)=MID$(X$,J,8)
1220 IFLEFT$(P$(R,1),1)=CHR$(255
)THENR=R-1:GOTO1280
1230 IFLEFT$(P$(R,1),1)=CHR$(0)T
HENR=R-1:GOTO1260
1240 P$(R,2)=MID$(X$,J+8,3)
1250 IFP$(R,2)<>"DAT"THENR=R-1
1260 NEXTJ
1270 RETURN
1280 FORK=1TOR
1290 PRINTUSING"###;K;:PRINT"] #
";P$(K,1),
1300 IFK=R THENPRINT,
1310 NEXTK
1320 LCN=480
1330 PRINT@LCN,"LOAD WHICH FILE
(M FOR MENU)";:INPUTP1$
1340 IFP1$="M"GOTO140
1350 P=VAL(P1$)
1360 IFP<1ORP>R THENLCN=448:GOTO
1330
1370 FILE$=P$(P,1)
1380 N$=FILE$
1390 GOTO490

```

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# Financing: The Economic Advantage

By Bill Bernico

**H**aving been a car salesman for six years and a car rental manager for another four years, I've learned a lot about human nature and how people spend their money. Folks purchasing a new car might think that by taking the money out of their savings account to pay cash for their purchase that they are saving all that interest on the loan. Surprise! They've actually lost money doing it that way. This program will show in cold, hard figures which is the more economical move. It will also give skeptics a printout to take home and think about if they are not initially convinced after running the program.

When using *Cash vs. Financing*, input the same dollar amounts and the same number of months in each case. In other words, compare "apples with apples." (Or should I say "CoCos with CoCos.") If you're considering a \$10,000 car and you have that amount in the bank, use \$10,000 in the financing section of the program in order to get an honest comparison.

Naturally, the input for interest will vary between savings and financing, but use the same number of months in the comparison. Let's go through a sample session. For savings amount, input \$10000 (no commas). For savings interest, let's use 8.75 (no percent sign necessary) and for months, input 48. Compound periods in this sample will be 2. The program will show you that by the end of the 48 month period, your nest egg will be worth \$14085.49 or a gain of \$4085.49 in interest.

This will put you into the finance part of the program. Your first input will be the finance amount. Again, use \$10000. For finance interest, use 13.5 (even at this higher rate, you'll be surprised by the outcome). For the number of fi-

nance months, again use 48 and it will show you that your monthly payment will be \$270.76 or a total of \$12996.48 over 48 months. The interest you will have paid in those 48 months is \$2996.48.

Comparing this figure with the \$4085.49 in interest you would have earned from the savings account, you can see that you've saved \$1089.01 by financing and leaving your nest egg alone. If you can find finance rates lower than 13.5, then the savings will be that much more.

At this point in the program, if the customer has still not been convinced to finance the car, the salesman can select from three options. Option 1 is a printout of the comparison. Option 2 is to start over with new figures. Option 3 is to end the program.

Option 1, the printout, will ask for the customer's name as well as the salesman's name. After the salesman inputs his name, the program will send the information to the printer. (This printout was tailored for the TP-10 printer which we have in our showroom, but will work with other printers as well.) The printout will personalize the hard-copy that the customer gets. It also has the dealership name and address as well as the salesman who serviced him. It's nice to stay fresh in the customer's mind.

Here is a sample printout from the program we just ran. This program need not be restricted to automobile purchases. It can be used on any item you like for comparison purposes.

One last note: I have fictionalized the name of the dealership in the printout as per my employer's request, and my apologies if there is really someone out there by the name of "Joe Average."

Sample Printout  
HOMETOWN DODGE  
1234 NORTH 56TH STREET  
SHEBOYGAN, WI 53081  
(414) 555-4861  
ASK FOR BILL BERNICO

SAVINGS AMOUNT.... 10000  
SAVINGS INTEREST.. 8.75 %  
SAVINGS MONTHS.... 48  
COMPOUND PERIODS.. 2  
SAVINGS AMOUNT  
AFTER 48 MONTHS... 14085.49  
INTEREST GAINED... 4085.49

FINANCE AMOUNT.... 10000  
FINANCE INT..... 13.5 %  
FINANCE MONTHS.... 48  
MONTHLY PMT..... 270.76  
TOTAL OF PMTS.... 12996.48  
TOTAL INTEREST.... 2996.48

JOE AVERAGE CAN SAVE \$ 1089.01  
BY FINANCING THIS VEHICLE

ASK US FOR ASSISTANCE IN  
ARRANGING A LOAN FOR YOU.

✓  
230 .....40  
430 .....211  
620 .....133  
END .....70

## The listing: CASH

```
10 ****          CASH          ***
20 **** BY BILL BERNICO ***
30 **** 708 MICHIGAN AV. ***
40 **** SHEBOYGAN, WI ***
50 ****      53081 ***
60 **** (414) 555-7350 ***
70 ****          ***
80 CLS:B$=CHR$(128)
90 PRINT@43,"advantages";B$;"of
100 PRINT@107,"financing";B$;"vs
110 PRINT@171,"paying";B$;"cash
120 PRINT@299,"COURTESY OF"
```

continued on Page 24

*Forecast your budget, so in the future  
you can . . .*

# Juggle Bills, Juggle Bills, Juggle All the Way!

By Glen Dufur

**T**his program, *Home Budget Analysis*, is used to assist in budgeting and forecasting personal finances in order to plan and adjust cash flow for three future periods (paydays). The program allows you to enter and update income and expense items for each of the three periods. The total of income and expenses is calculated and displayed for instant analysis of cash flow, as items are added or updated. The balance is money that has not been committed, or over-committed, if a negative balance is calculated.

As a period passes, you may shift all amounts so the second period becomes current and a new third period is opened. This allows you to continue budgeting for future periods. Also the ability is given to save or load a file of personal finance data.

## Create New File/Load Existing File

You are given two options upon running the program. Press 'C' to create a new file or 'L' to load an existing file.

- **Create New File:** You are prompted to enter the dates of the three future periods to be budgeted. Enter each period date in the format "MM/DD."
- **Load Existing File:** You are prompted to ready the cassette. Press any key when ready to load the file.

Upon completion of entering the dates for creation of a new file or loading an existing file, the INCOME DISPLAY appears. You are now ready to begin entry or update of your personal finance file.

## Add/Update/Delete Expense and Income Items

Income items are accessed via the income display, expense items via the expense display. Press 'N' to add a new item, or "A-H" to update or delete an

existing item. Be sure to include all known income and expenses that occur during each period, for example, groceries, car expenses, rent, utilities, installment payments, savings, wages and other income.

- **Add Item:** A prompt is given to enter the DESCRIPTION. A description is required for each item entered. You are then prompted to enter an AUTO AMOUNT. This amount is automatically entered for each period of the item being added. Press ENTER without an amount if you do not wish an auto amount. This function is handy when the amount is the same for each period. You are now ready to enter amounts for the added item (see Update).
- **Update Item:** When updating an item, the display prompts for the period to update, '1', '2' or '3'. Enter the proper period and a prompt appears to enter the AMOUNT. To change the description and/or auto amount, press 'D'. A prompt appears to enter the new description. You are then prompted to enter the auto amount.
- **Delete Item:** After selecting the item to be deleted, press '\*'. The item is deleted and you are automatically returned to the income or expense display. Press 'R' to return to the income or expense display.

## Expense and Income Displays

The income and expense displays list the items that represent the total of expenses and income. Options are available to move between the expense and income displays, in addition to adding or updating items. Press 'I' while in the expense display to call the income display. The expense display may be recalled by pressing 'X'.

Scrolling of items is accomplished by

the up/down arrows while in either display. The last entry on the screen appears at the top when scrolled down and vice versa when scrolled up.

The calculated total of expenses and income is shown for each period with the balance of uncommitted or over-committed amounts.

## Open New Period

As a period has past, you may delete the current period and move all income and expenses forward and, therefore, open a new period.

Press 'O' while in the expense or income display. The function prompts you to enter the date of the new period in the form "MM/DD." The program automatically shifts all amounts and drops the values for the current period. If you had entered an auto amount for any income or expense item, this amount is automatically entered into the new period for the item.

## Technical Information

A maximum of 25 expense items and five income items have been imposed. Should your budget require more items, change the value of EN (expense items) and IN (income items) in Line 3000.

## Logic Flow

### Frequent Subroutines

- 10 INKEY
- 12 prompt alarm
- 15 blank two lines
- 20 top line
- 25 bottom line
- 30 screen load expenses
- 45 screen load income
- 60 calculate and print totals


### Other Subroutines

- 100 accept desc/default
- 120 delete expense
- 130 delete income

140 accept amount  
150 basic screen  
170 item screen  
185 item bottom query  
190 file full  
300 expense display  
400 expense item update  
500 income display  
600 income item update  
700 shift period  
800 LOAD and SAVE  
900 new file

1000 initialize and start  
1100 menu  
2000 PCLEAR  
**Variables**  
ED\$(EN) expense description  
EA(EN,3) expense amount  
DE(EN) expense default  
LE last record expense  
ID\$(IN) income description  
IA(IN,3) income amount  
DA(IN) income default  
LI last record income

PD\$(3) period dates  
TE(3) period total expense  
TI(3) period total income  
PB(3) period balance  
EN maximum expense records  
(preset to 25)  
IN maximum income records  
(preset to 5)  
IE\$ flag E=expense, I=income  
I(8) item addressability  
IX\$(8) item addressability  
IS(8) item addressability



40	.....33	610	.....78
80	.....179	720	.....82
130	.....99	835	.....89
170	.....1	997	.....15
320	.....230	1110	.....140
430	.....36	END	.....183

### The listing: HOMEBDGT

```
1 GOTO2000
7 '
8 'FREQUENT SUBROUTINES
9 '
10 K$=INKEY$:IFK$="" THENGOTO100EL
SEK=VAL(K$):RETURN
12 FORSS=1TO2:SOUND220,1:NEXTSS:
RETURN
13 FORSS=1TO9:SOUND220,1:NEXTSS:
RETURN
15 PRINTTAB(1)STRING$(30," "):PR
INTTAB(1)STRING$(30," "):RETURN
20 PRINTTAB(1)STRING$(30,CHR$(14
0)):RETURN
25 PRINTTAB(1)STRING$(30,CHR$(13
1)):RETURN
30 IFLE=0 THENPRINT@163,"enter"B
B$;"expense"BB$"items";:SOUND200
,1:RETURN
31 PP=64:PX=PP:IX=1:FORX=I(1) TO
(I(1)+6):PRINT@PP+0,STRING$(32,C
HR$(143));
35 IFX<(EN+1) THENPX=PP:PRINT@PP
+0,IX$(IX):PX=PX+1:PRINT@PX,USI
NG"%"%";ED$(X):PX=PX+7:FORX=
1TO3:IFEA(X,Y)<>0 THENPRINT@PX,U
SING N2$;EA(X,Y):PX=PX+8:NEXTY:
ELSEPX=PX+8:NEXTY
40 I(IX)=X:IX=IX+1:PP=PP+32:NEXT
X:SOUND200,1:RETURN
45 IFLI=0 THENPRINT@163,"enter"B
B$;"income"BB$"items";:SOUND200,
1:RETURN
46 PP=64:PX=PP:IX=1:FORX=I(1) TO
(I(1)+6):PRINT@PP+0,STRING$(32,C
HR$(143));
50 IFX<(IN+1) THENPX=PP:PRINT@PP
+0,IX$(IX):PX=PX+1:PRINT@PX,USI
NG"%"%";ID$(X):PX=PX+7:FORX=
1TO3:IFIA(X,Y)<>0 THENPRINT@PX,U
SING N2$;IA(X,Y):PX=PX+8:NEXTY:
ELSEPX=PX+8:NEXTY
55 I(IX)=X:IX=IX+1:PP=PP+32:NEXT
X:SOUND200,1:RETURN
60 FORX=1TO3:TE(X)=0:FORX=1TOLE:
TE(X)=TE(X)+EA(Y,X):NEXTX,X:FORX
=1TO3:TI(X)=0:FORX=1TOLI:TI(X)=T
I(X)+IA(Y,X):NEXTX,X:FORX=1TO3:P
B(X)=TI(X)-TE(X):NEXTX
65 PRINT@288,CHR$(140):GOSUB20:
PRINT@320,"expense";PP=320:FORX
=1TO3:PP=PP+8:PRINT@PP,USINGN2$;
TE(X):NEXTX
70 PRINT@352,"income";BB$:PP=35
2:FORX=1TO3:PP=PP+8:PRINT@PP,USI
NGN2$;TI(X):NEXTX
75 PRINT@384,"balance";PP=384:F
ORX=1TO3:PP=PP+8:PRINT@PP,USING
N2$;PB(X):NEXTX
80 PRINT@416,CHR$(131):GOSUB25:
RETURN
```

```
97 '
98 'OTHER SUBROUTINES
99 '
100 PRINT@448,"";GOSUB15:PRINT@
449,"";GOSUB12:LINEINP"DESC:
";XX$:IFXX$="" THENSOUND1,1:GOTO
100ELSEPRINT@132,"*** "XX$" ***"
;
102 PRINT@448,"";GOSUB15:PRINT@
449,"AUTO AMOUNT";GOSUB12:INPUT
XX
105 IFIE$="E" THENED$(I)=XX$:DE(
I)=XX:IFEA(I,1)=0 ANDEA(I,2)=0 A
NDEA(I,3)=0 THENFORX=1TO3:EA(I,X
)=DE(I):NEXTX:RETURN:ELSERETURN
110 ID$(I)=XX$:DI(I)=XX:IFIA(I,1
)=0 ANDIA(I,2)=0 ANDIA(I,3)=0 TH
ENFORX=1TO3:IA(I,X)=DI(I):NEXTX:
RETURN:ELSERETURN
120 IFI=LE THENED$(I)="" :DE(I)=0
:FORZ=1TO3:EA(I,Z)=0:NEXTZ:LE=LE
-1:ELSEFORX=1 TOLE-1:IFED$(X+1)
<>"" THENED$(X)=ED$(X+1):ED$(X+1
)="" :DE(X)=DE(X+1):DE(X+1)=0:FOR
Z=1TO3:EA(X,Z)=EA(X+1,Z):EA(X+1,
Z)=0:NEXTZ:NEXTX:LE=LE-1: ELSENE
XTX
125 RETURN
130 IFI=LI THENID$(I)="" :DI(I)=0
:FORZ=1 TO3:IA(I,Z)=0:NEXTZ:LI=LI
-1:ELSEFORX=1 TOLI-1:IFID$(X+1)
<>"" THENID$(X)=ID$(X+1):ID$(X+1
)="" :DI(X)=DI(X+1):DI(X+1)=0:FO
RZ=1TO3:IA(X,Z)=IA(X+1,Z):IA(X+1
,Z)=0:NEXTZ:NEXTX:LI=LI-1: ELSEN
EXTX
135 RETURN
140 PRINT@448,"";GOSUB15:PRINT@
449,"PERIOD"K"AMOUNT";GOSUB12:I
NPUTXX:IFIE$="E" THENEA(I,K)=XX
ELSEIA(I,K)=XX
145 RETURN
150 CLS:PRINT"";IFIE$="E" THENP
RINTSTRING$(32,CHR$(242)); ELSEP
RINTSTRING$(32,CHR$(162));
155 PRINT@16,"display";BB$;PRIN
T@32,BB$;"period";:PRINT@42,USI
NGN3$;PD$(1):PRINT@50,USINGN3$;
PD$(2):PRINT@58,USINGN3$;PD$(3)
;:IFIE$="E" THEN160 ELSE165
160 PRINT@7,BB$;"expense";BB$;P
RINT@449,"a-h NEW EXPENSE INCO
ME SAVE";:PRINT@481," <ARROWS>
OPEN NEW PERIOD";:RETURN
165 PRINT@8,BB$;"income";BB$;PR
INT@449,"a-h NEW INCOME EXPENS
E SAVE";:PRINT@481," <ARROWS>
OPEN NEW PERIOD";:RETURN
170 CLS:PRINT@193," PERIOD
AMOUNT ";:PRINT@227,STRING
$(10,CHR$(131));:PRINT@242,STRIN
G$(8,CHR$(131));:PRINT@385,"AUTO
AMOUNT";:PRINT@416,"";:GOSUB25
175 PRINT@32,"";:GOSUB20:PRINT:I
FIE$="E" THENPRINTTAB(5)"EXPENSE
ITEM UPDATE":ELSEPRINTTAB(5)"IN
COME ITEM UPDATE"
180 GOSUB25:RETURN
185 PRINT@449,"";GOSUB15:PRINT@
449," UPDATE PERIOD <1> <2> <3
>
DESC *DELETE NEW ITEM RET
URN";:RETURN
```

```
190 PRINT@449,"";GOSUB15:PRINT@
449," file full - press enter";:
GOSUB10:RETURN
297 '
298 'EXPENSE ITEM UPDATE
299 '
300 IE$="E":I(1)=1
305 PP=32:GOSUB150:GOSUB60:GOSUB
30
310 I=0:GOSUB10
315 IFK$=CHR$(10) THENI(1)=I(1)+
6:IFI(1)>LE THENI(1)=LE:GOSUB30:
GOTO310:ELSEGOSUB30:GOTO310
320 IFK$="^" THENI(1)=I(1)-6:IF
I(1)<1 THEN I(1)=1:GOSUB30:GOTO31
0 ELSEGOSUB30:GOTO310
325 IFK$="N" THENGOSUB400:GOTO300
5:ELSEIFK$="I" THEN500 ELSEIFK$=
"S" THENIO=2:GOSUB800:GOTO300 EL
SEIFK$="O" THENGOSUB700:GOTO300
330 FORX=1TO8:IFK$=IS(X) THENI=I
(X):NEXTX:ELSENEXTX
335 IFI=0 THEN340 ELSEIFI>ENTRIE
S THEN340 ELSEIFED$(I)="" THEN34
0 ELSEGOSUB400:GOTO305
340 SOUND1,1:GOTO310
397 '
398 'EXPENSE ITEM UPDATE
399 '
400 SOUND200,1
405 IFK$="N" THENLE=LE+1:I=LE:IF
LE>EN THENLE=EN:GOSUB190:RETURN
410 GOSUB170:PRINT@132,"*** "ED$(
I) ***";:PP=259:FORX=1TO3:PRIN
T@PP,X:PRINT@PP+2,">";:PRINT@PP
+4,USINGN3$;PD$(X):PRINT@PP+15,
USING N2$;EA(I,X):PP=PP+32:NEXT
X:PRINT@402,USINGN2$;DE(I):
415 IFK$="N" THENGOSUB100:K$="":
GOTO410: ELSEGOSUB185
420 GOSUB10:IFK$="R" THENRETURN
ELSEIFK$="*" THENGOSUB120:RETURN
:ELSEIFK$="D" THENGOSUB100:GOTO4
00ELSEIFK$="N" THENGOTO400
425 IF K>0 AND K<4 THENGOSUB140:
GOTO410
430 SOUND1,1:GOTO420
497 '
498 'INCOME DISPLAY
499 '
500 IE$="I":I(1)=1
505 PP=32:GOSUB150:GOSUB60:GOSUB
45
510 I=0:GOSUB10
515 IFK$=CHR$(10) THENI(1)=I(1)+
6:IFI(1)>LI THENI(1)=LI:GOSUB45:
GOTO510:ELSEGOSUB45:GOTO510
520 IFK$="^" THENI(1)=I(1)-6:IF
I(1)<1 THEN I(1)=1:GOSUB45:GOTO51
0 ELSEGOSUB45:GOTO510
525 IFK$="N" THENGOSUB600:GOTO500
0:ELSEIFK$="X" THEN300 ELSEIFK$=
"S" THENIO=2:GOSUB800:GOTO300 EL
SEIFK$="O" THENGOSUB700:GOTO500
530 FORX=1TO8:IFK$=IS(X) THENI=I
(X):NEXTX:ELSENEXTX
535 IFI=0 THEN540 ELSEIFI>9 THEN
540 ELSEIFID$(I)="" THEN540 ELSE
GOSUB600:GOTO505
540 SOUND1,1:GOTO510
597 '
598 'INCOME ITEM UPDATE
```

```

599 '
600 SOUND200,1
605 IFK$="N" THEN LI=LI+1:I=LI:IF
LI>IN THEN LI=IN:GOSUB190:RETURN
610 GOSUB170:PRINT@132,"*** ID$
(I) ***";PP=259:FORX=1TO3:PRIN
T@PP,X;:PRINT@PP+2,">";:PRINT@PP
+5,USINGN3$;PD$(X);:PRINT@PP+15,
USING N2$;IA(X,I,X);:PP=PP+32:NEXT
X:PRINT@402,USINGN2$;DI(I);
615 IFK$="N" THENGOSUB100:K$="":
GOTO610: ELSEGOSUB185
620 GOSUB100:IFK$="R" THENRETURN
ELSEIFK$="*" THENGOSUB130:RETURN
:ELSEIFK$="D" THENGOSUB100:GOTO6
00ELSEIFK$="N" THENGOTO600
625 IF K>0 AND K<4 THENGOSUB140:
GOTO610
630 SOUND1,1:GOTO620
697 '
698 'OPEN NEW PERIOD
699 '
700 CLS:SOUND200,1
705 PRINT@129,STRING$(30,CHR$(14
0)):PRINTTAB(3)"SHIFT AND OPEN N
EW PERIOD":PRINT TAB(1)STRING$(3
0,CHR$(131))
710 GOSUB12:PRINT@292,"HIT ANY K
EY TO CONTINUE OR r
ETURN";:GOSUB100:IF K$="R" THENRE
TURN
715 PRINT@288,"":GOSUB15,:PRINT@
289,"ENTER NEW PERIOD DATE (MM/D
D)":PRINT@335,"":GOSUB12:LINEI
NPUT";XX$:PRINT@288,"":GOSUB15
:PRINT@294,"NEW PERIOD FOR ";XX$
:PRINTTAB(6)"NOW BEING OPENED";
720 FORX=1TOLE:EA(X,1)=EA(X,2):E
A(X,2)=EA(X,3):EA(X,3)=DE(X):NEX
TX:FORX=1TOLI:IA(X,1)=IA(X,2):IA
(X,2)=IA(X,3):IA(X,3)=DI(X):NEXT
X:PD$(1)=PD$(2):PD$(2)=PD$(3):PD
$(3)=XX$:RETURN
797 '
798 'I/O ROUTINES
799 '
800 CLS:SOUND200,1
805 IFIO=1 THENIO$="LOAD" ELSEIO

```

```

$="SAVE"
810 PRINT@64,"":GOSUB20:PRINT@1
05,IO$;" FILE";:PRINT@128,"":GO
SUB25
815 GOSUB13:PRINT@193,"POSITION
TAPE...":PRINT" READY CASSETTE.
."PRINT" PRESS ANY KEY TO CONTI
NUE":GOSUB10:PRINT@192,"":GOSUB1
5:GOSUB15:IFIO=2 THEN845
820 '----LOAD FILE----
825 SOUND220,1:PRINT@193," LOADI
NG BUDGET FILE";
830 OPEN"1",#-1,"BUDGET":SOUND22
0,1
835 INPUT#-1,LE,LI:FORX=1TOLE:IN
PUT#-1,ED$(X),DE(X):FORX=1TO3:IN
PUT#-1,EA(X,Y):NEXTY,X:FORX=1TOL
I:INPUT#-1,ID$(X),DI(X):FORX=1TO
3:INPUT#-1,IA(X,Y):NEXTY,X:FORX=
1TO3:INPUT#-1,PD$(X):NEXTX
840 CLOSE#-1:RETURN
845 SOUND220,1
850 PRINT@193," SAVING BUDGET FI
LE";:MOTORON:FORX=1TO600:NEXTX
855 OPEN "0",#-1,"BUDGET":SOUND2
20,1
860 PRINT#-1,LE,LI:FORX=1TOLE:PR
INT#-1,ED$(X),DE(X):FORX=1TO3:PR
INT#-1,EA(X,Y):NEXTY,X:FORX=1TOL
I:PRINT#-1,ID$(X),DI(X):FORX=1TO
3:PRINT#-1,IA(X,Y):NEXTY,X:FORX=
1TO3:PRINT#-1,PD$(X):NEXTX
865 CLOSE#-1:RETURN
897 '
898 'CREATE NEW FILE
899 '
900 CLS:SOUND200,1
905 PRINT@33,"":GOSUB20:PRINT:PR
INTTAB(6)"ENTER PERIOD DATES":GO
SUB25
910 PP=360:FORX=1TO3:PRINT@214,"
":GOSUB15:PRINT@161,"PERIOD #";
X;:PRINT@227,"":GOSUB12:LINEINP
UT"ENTER DATE (MM/DD)":PD$(X):
PRINT@PP,"PERIOD ";X"--> ":PRIN
TUSINGN3$;PD$(X):PP=PP+32:NEXTX:
GOTO500
997 '

```

```

998 'INITIALIZE PROGRAM
999 '
1000 CLEAR500:SOUND200,1:EN=25:I
N=5:DIMED$(EN):DIMEA(EN,3):DIMP
D(3):DIMA(EN,3):DIMIS(8):DIMI(8
):DIMDE(EN):DIMID$(EN):DIMDI(EN
):DIMIX(8):DIMTE(3):DIMTI(3):DIM
PB(3)
1005 LE=0:LI=0:FORX=1TO8:READIX$
(X),IS(X),I(X):NEXTX
1010 DATA a,A,1,b,B,2,c,C,3,d,D,
4,e,E,5,f,F,6,g,G,7,h,H,8
1015 N0$="###":N2$="####.##-":N1$
="#####.###":LD$="%" :N3$="%"
%":BB$=CHR$(128)
1030 '
1100 SOUND200,1
1105 CLS:PRINT@99,"home";BB$;"bu
dget";BB$;"analysis":PRINT:PRINT
" BY: GLEN DUFUR":PRINT" C
OPYRIGHT (C) 1985"
1110 PRINT:PRINTTAB(4)"LOAD EXIS
TING BUDGET FILE":PRINT:PRINTTAB
(4)"CREATE NEW BUDGET FILE":PRIN
T@424,"SELECT OPTION";
1115 IFXX$=CHR$(161) THENXX$=CHR
$(162):XY$=CHR$(164):XZ$=CHR$(16
6): ELSEXX$=CHR$(161):XY$=CHR$(1
68):XZ$=CHR$(169)
1120 PRINT@65,CHR$(138);:PRINTST
RING$(22,XX$);CHR$(133);:PRINT@1
29,CHR$(138);STRING$(22,XY$);CHR
$(133);:K$=INKEY$:PRINT@97,CHR$(
138);XZ$:PRINT@119,XZ$;CHR$(133
)
1125 PRINT@438," ":IFK$=" " THEN
1115 ELSEIFK$="L" THENIO=1:GOSUB
800:GOTO500: ELSEIFK$="C" THEN90
0
1130 PRINT@438,K$;:SOUND1,5:GOTO
1115
1200 'CSAVE "BUDGET" ROUTINE
1205 FORX=1TO2:MOTORON:FORX=1TO6
00:NEXTX:MOTOROFF:CSAVE"BUDGET":
NEXTX:FORX=1TO5:SOUND200,1:NEXT:
END
1999 'PCLEAR ROUTINE
2000 PCLEAR1:GOTO1000

```

continued from Page 21

```

130 PRINT@363,"HOMETOWN DODGE
140 PRINT@484,"(HIT ANY KEY TO C
ONTINUE)";
150 EXEC 44539
160 A=0:I=0:T=0:Y=0:V=0:L=0:P=0:
X=0:N=0:K=0:O=0:U=0:E=0
170 CLS
180 INPUT"SAVINGS AMOUNT.....";
A
190 INPUT"SAVINGS INTEREST....";
I:I=I/100
200 INPUT"SAVINGS MONTHS.....";
T:T=T/12
210 INPUT"COMPOUND PERIODS....";
Y
220 V=A*(1+I/Y)^(Y*T):V=INT(V*100
0+.5)/100
230 PRINT"AFTER";T*12;"MONTHS...
..$";V
240 L=V-A
250 PRINT"INTEREST GAINED.....$
";L
260 PRINTSTRING$(32,"-");
270 INPUT"FINANCE AMOUNT.....";
P
280 INPUT"FINANCE INTEREST....";
X:X=X/100
290 INPUT"FINANCE MONTHS.....";
N
300 K=P*(X/12)/(1+(X/12))^(N)
310 K=INT(K*100+.5)/100
320 PRINT"MONTHLY PAYMENT.....$
";K
330 O=K*N
340 O=INT(O*100+.5)/100
350 PRINT"TOTAL OF PAYMENTS...$"

```

```

;O
360 U=INT((O-P)*100+.5)/100
370 PRINT"TOTAL INTEREST.....$
";U
380 E=INT((L-U)*100+.5)/100
390 PRINT"AMOUNT SAVED
400 PRINT"BY FINANCING.....$
";E
410 PRINT@482,"PRINTOUT START O
VER END";
420 A$=INKEY$:IF A$=" "THEN 420
430 IF A$="S"THEN 160
440 IF A$="P"THEN 470
450 IF A$="E"THEN 10
460 GOTO 420
470 CLS:INPUT"CUSTOMER'S NAME";C
N$
480 INPUT"SALESMAN'S NAME";SN$
490 CLS:PRINT@232,"....PRINTING.
...
500 PRINT#-2," HOMETOWN D
ODGE
510 PRINT#-2," 1234 NORTH 56T
H STREET
520 PRINT#-2," SHEBOYGAN, WI
53081
530 PRINT#-2," (414) 555
-4861
540 PRINT#-2,"ASK FOR ";SN$
550 PRINT#-2
560 PRINT#-2,"SAVINGS AMOUNT....
";A
570 I=I*100
580 PRINT#-2,"SAVINGS INTEREST..
";I;"$
590 T=T*12
600 PRINT#-2,"SAVINGS MONTHS....
";T
610 PRINT#-2,"COMPOUND PERIODS..
";Y

```

```

620 PRINT#-2,"SAVINGS AMOUNT"
630 PRINT#-2,"AFTER";T;"MONTHS..
..$";V
640 PRINT#-2,"INTEREST GAINED...
";L
650 PRINT#-2
660 PRINT#-2,"-----
-----
670 PRINT#-2
680 PRINT#-2,"FINANCE AMOUNT....
";P
690 X=X*100
700 PRINT#-2,"FINANCE INT.....
";X;"$
710 PRINT#-2,"FINANCE MONTHS....
";N
720 PRINT#-2,"MONTHLY PMT.....
";K
730 PRINT#-2,"TOTAL OF PMTS.....
";O
740 PRINT#-2,"TOTAL INTEREST....
";U
750 PRINT#-2
760 PRINT#-2,CN$;" CAN SAVE $";E
770 PRINT#-2,"BY FINANCING THIS
VEHICLE
780 PRINT#-2
790 PRINT#-2,"ASK US FOR ASSISTA
NCE IN
800 PRINT#-2,"ARRANGING A LOAN F
OR YOU.
810 PRINT#-2:PRINT#-2:PRINT#-2:P
RINT#-2:PRINT#-2:PRINT#-2
820 CLS:PRINT@481,"another PRINT
OUT RESTART END";
830 A$=INKEY$:IFA$=" "THEN830
840 IF A$="A"THEN 500
850 IF A$="R"THEN 160
860 IF A$="E"THEN 10
870 GOTO 830

```



# The Joy\$ of Early Amortization

By Edward R. Carson

**P**aying off a mortgage early to get a quicker equity buildup is the best idea I (a homeowner) have heard of in a long time. It used to cost a little extra each month to reach this goal, but a new kind of mortgage is just now taking hold in the United States that can make the process almost painless. Quicker mortgage payoff will save you a fortune in interest rates and can take years off the repayment schedule. It also has two strategic uses.

A young couple who pays off their mortgage early will then have a huge amount of equity on tap. This is also a method of forced savings; all of these gains are tax deferred. A quick payment mortgage is also suitable for middle-aged home buyers who want to own their home free and clear by the time they retire. The new way to faster home ownership is through a bi-weekly mortgage payment plan. The loan is amortized as if it were going to last for 30 years, but instead of paying once a month, one half the payment is made every two weeks. This method of repayment leads to the equivalent of 13 monthly payments rather than the usual 12. This may not sound like it would make a lot of difference, but the amount of money and time saved is astounding, as you will see when comparing Option 1 with Option 2. Since this method of repayment is not available with all lenders, two other options are included that can have the same effect and are accepted by most lenders.

*Edward R. Carson is a head operator at the Timken Company in Columbus, Ohio. His interests encompass computers and baseball. He is married and has three sons.*

There are two parts to the *Mortgage Planner*. The first part is a loan calculator. If you are planning a home purchase, the calculator figures your principal and interest payments. It returns the amount financed, amount of payment, interest rate and number of months required to retire the loan (see Figure 1). If you know the amount you want to pay per month but don't know the amount you can finance to arrive at your target payment, the calculator can help. When asked the amount to finance, just press ENTER; you are then asked the amount per month (enter what you want to pay per month) and the calculator gives the amount to finance and arrives at your target payment. You can go through as many

calculations as you wish. The last amount calculated is automatically forwarded to the *Mortgage Planner*. It is not necessary to go to the calculator. If you have an existing mortgage, go directly to the Planner.

The *Mortgage Planner* has four options to choose from. Each is a different method of repayment. Three of these options can save thousands of dollars and many years off the mortgage. The

Figure 1

AMOUNT OF THE LOAN	\$ 36000.00
NO. OF MONTHS	360
INTEREST RATE	10 %
MONTHLY PAYMENTS	\$ 315.93

## Option 1

YEAR	INT. PAID	PRINCIPAL PAID	
1	\$ 3590.17	\$ 200.94	/
2	\$ 7159.30	\$ 422.92	/
3	\$ 10705.20	\$ 668.13	/
4	\$ 14225.42	\$ 939.02	/
5	\$ 17717.28	\$ 1238.26	/
6	\$ 21177.82	\$ 1568.84	/
7	\$ 24603.75	\$ 1934.02	/
8	\$ 27991.44	\$ 2337.43	/
9	\$ 31336.91	\$ 2783.07	/
10	\$ 34635.72	\$ 3275.37	/
11	\$ 37882.99	\$ 3819.21	/
12	\$ 41073.33	\$ 4419.98	/
13	\$ 44200.78	\$ 5083.64	/
14	\$ 47258.75	\$ 5816.78	/
15	\$ 50239.96	\$ 6626.68	/
16	\$ 53136.39	\$ 7521.36	/
17	\$ 55939.15	\$ 8509.70	/
18	\$ 58638.45	\$ 9601.51	/
19	\$ 61223.45	\$ 10807.63	/
20	\$ 63682.17	\$ 12140.01	/
21	\$ 66001.42	\$ 13611.88	/
22	\$ 68166.57	\$ 15237.83	/
23	\$ 70161.51	\$ 17034.00	/
24	\$ 71968.40	\$ 19018.22	/
25	\$ 73567.57	\$ 21210.16	/
26	\$ 74937.27	\$ 23631.57	/
27	\$ 76053.47	\$ 26306.48	/
28	\$ 76889.64	\$ 29261.42	/
29	\$ 77416.46	\$ 32525.71	/
YEARS	TOTAL INTEREST	TOTAL PRINCIPAL	
30.0	\$ 77733.28	\$ 36000.00	

## Option 2

YEAR	INT. PAID	PRINCIPAL PAID	
1	\$ 3564.58	\$ 542.46	/
2	\$ 7072.38	\$ 1141.69	/
3	\$ 10517.47	\$ 1803.63	/
4	\$ 13893.28	\$ 2534.85	/
5	\$ 17192.57	\$ 3342.60	/
6	\$ 20407.32	\$ 4234.89	/
7	\$ 23528.68	\$ 5220.56	/
8	\$ 26546.89	\$ 6309.39	/
9	\$ 29451.14	\$ 7512.17	/
10	\$ 32229.51	\$ 8840.84	/
11	\$ 34868.83	\$ 10308.55	/
12	\$ 37354.54	\$ 11929.88	/
13	\$ 39670.57	\$ 13720.89	/
14	\$ 41799.13	\$ 15699.34	/
15	\$ 43720.67	\$ 17884.85	/
16	\$ 45413.47	\$ 20299.09	/
17	\$ 46853.60	\$ 22966.00	/
18	\$ 48014.61	\$ 25912.02	/
19	\$ 48867.30	\$ 29166.36	/
20	\$ 49379.40	\$ 32761.30	/
<b>YEARS</b>	<b>TOTAL INTEREST</b>	<b>TOTAL PRINCIPAL</b>	
22.6	\$ 49615.88	\$ 36000.00	

choice of on-screen or printer displays is given. The printer routine gives a year-by-year printout of interest paid, principal, paid outstanding balance, total payments, and years and months required to retire the loan. There is an on-screen bar graph of interest paid at all options. Any calculated screen can also be dumped to the printer by pressing the 'P' key. I found this easier than writing down all the information on a scratch pad. The amount of money that can be saved with just a little extra each month literally amazes me, as I am sure it will you.

(Any questions you have about *Mortgage Planner* may be directed to Mr. Carson at 7600 Condit Road, Centerburg, OH 43011, phone 614-625-6936. Please include an SASE when writing.) □

```

111 .....218 1001 .....207
191 .....141 1061 .....5
301 .....62 1111 .....120
391 .....7 1151 .....105
496 .....209 1246 .....208
556 .....1 1341 .....22
666 .....139 1441 .....197
771 .....54 1481 .....136
821 .....231 1571 .....240
921 .....242 END .....83

```

### The listing: MORTGAGE

```

1 Y=1
6 CLS
11 X=32
16 CLS
21 Z$="SAVE"
26 PRINT@X,Z$
31 X=X+10
36 IFX=382 THEN 41 ELSE 26
41 FORT=1T080:NEXTT
46 Y=Y+1:IFY=5THEN51ELSE6
51 FORT=1T0500:NEXTT
56 CLS:PRINT@164,"the mortgage p
lanner"
61 PRINT@236,"by"
66 PRINT@294,"edward r carson"
71 GOSUB1181
76 GOTO1021
81 CLS
86 PRINT:PRINT:PRINT "YOU HAVE F
OUR OPTIONS WITH THIS PORTION OF
THE PROGRAM..."
91 PRINT:PRINTTAB(7)"THEY ARE AS
FOLLOWS..."
96 PRINT:PRINT:PRINT"HIT ANY KEY
TO CONTINUE"
101 K$=INKEY$:IFK$=""THEN 101ELS
E106
106 CLS:PRINT"1) CONTINUE TO MAK
E NORMAL MONTHLY PAYMENTS
..."
111 PRINT:PRINT"2) MAKE 1/2 OF N
ORMAL PAYMENT EVERY 14 DAYS.
..."
116 PRINT:PRINT"3) LUMP SUM (IN
EXCESS OF NORMAL PAYMENT) ONCE
EACH YEAR..."
121 PRINT:PRINT"4) INCREASE MONT
HLY PAYMENT BY (X) AMOUNT...(X
) AMOUNT USED TO REDUCE BALANCE
ON A MONTHLY BASIS"
126 PRINT"HIT ANY KEY TO CONTINU
E"

```

```

131 K$=INKEY$:IFK$=""THEN 131ELS
E 136
136 CLS:PRINT@75,"options"
141 PRINT:PRINTTAB(10)"1 2 3
4"
146 PRINT:PRINTTAB(10)"select on
e"
151 PRINTSTRING$(32,"*")
156 PRINT"1= NORMAL PAYMENT"
161 PRINT:PRINT"2= 1/2 NORMAL PA
YMENT"
166 PRINT:PRINT"3= LUMP SUM"
171 PRINT:PRINT"4= EXCESS MONTHL
Y"
176 INPUT S
181 ON S GOTO 231,546,821,841
186 CLS:PRINT@195,"what is your
normal...."
191 PRINT@263,"monthly payment..
..."
196 INPUT NP
201 CLS:PRINT@193,"what is your
interest rate...."
206 PRINT@258,"input as per exam
ple <.0950 >"
211 INPUT AI
216 CLS:PRINT@192,"what is your
current balance.."
221 INPUT CB
226 GOTO 81
231 CLS:PRINT@260,"DO YOU WANT A
PRINTOUT OF..."
236 PRINT@324,"YEARLY ANALYSIS..
..."
241 PRINT:PRINTTAB(11)" ( Y/N )"
246 K$=INKEY$:IFK$=""THEN246
251 IFK$="Y"THEN 421ELSEIFK$="N"
THEN256
256 CLS:PRINT@196,"calculating t
otals..."
261 PRINT@260,"please stand by..
..."
266 POKE 65495,0
271 DP=30.41:Z=1
276 DI=AI/365
281 IN=DI*CB*DP
286 P=NP-IN
291 PB=PB+P+EP
296 CB=CB-P
301 TP=TP+NP+EP
306 TI(S)=TI(S)+IN
311 CB=CB-EP
316 IF CB<=0THEN326ELSE321
321 IFZ=M THEN831ELSEZ=Z+1:GOTO2
81
326 TI(S)=TI(S)-CB:PB=PB+CB
331 CLS:PRINTTAB(12)"OPTION ";S
336 PRINT:PRINT"INTEREST PAID";:
PRINTTAB(21);:PRINTUSING"#####

```

```

.###;TI(S)
341 PRINT"PRINCIPAL PAID";:PRINT
TAB(21);:PRINTUSING"#####.###;
PB
346 PRINTTAB(21)STRING$(10,"-")
351 PRINT"TOTAL PAID";:PRINTTAB(
21);:PRINTUSING"#####.###;TP
356 Z=Z/12
361 PRINT:PRINT"YEARS TO RETIRE
LOAN.. ";:PRINTUSING"###.###;Z
366 PRINT"NORMAL PAYMENT.....
";:PRINTUSING"#####.###;NP
371 PRINT"INTEREST RATE.....
";AI;"%"
376 IFS=3GOSUB1426ELSEIFS=4GOSUB
1431
381 POKE 65494,0
386 C$=INKEY$:IFC$=""THEN386
391 IFC$="P"THENGOSUB 1381ELSE 3
96
396 IF S=4 THEN GOSUB 1246:GOTO
401
401 CB=PB:PB=0:Z=0:TB=0:TP=0:LS=
0:EP=0
406 PRINT:PRINT"DO YOU WANT THIS
OPTION AGAIN"
411 PRINTTAB(12)"( Y/N )":INPUT
C$:IFC$="N"THEN 136 ELSE 416
416 TI(S)=0:GOTO 136
421 CLS:PRINT@264,"now printing"
426 PRINT#-2,TAB(30)"OPTION ";S
431 IFS=3GOSUB851
436 IFS=4GOSUB856
441 PRINT#-2,"YEAR";TAB(6)"INT.P
AID";TAB(18)"PRINCIPAL PAID";T
AB(35)"TOTAL PAYMENT";TAB(51)"OUTS
TANDING BALANCE"
446 DP=30.41:Z=1:H=12:Y=1
451 DI=AI/365
456 IN=DI*CB*DP
461 P=NP-IN
466 PB=PB+P+EP
471 CB=CB-P
476 TP=TP+NP+EP
481 TI(S)=TI(S)+IN
486 CB=CB-EP
491 IFCB<=0THEN511ELSE496
496 IFZ=H THEN836ELSEZ=Z+1:GOTO4
56
501 IFCB<0THENCB=0
506 PRINT#-2,Y;:PRINT#-2,TAB(6);
:PRINT#-2,USING"#####.###;TI(S
);:PRINT#-2,TAB(18);:PRINT#-2,US
ING"#####.###;PB;:PRINT#-2,TAB
(35);:PRINT#-2,USING"#####.###
";TP;:PRINT#-2,TAB(51);:PRINT#-2,
USING"#####.###;CB:Y=Y+1:H=H+1
2:GOTO456
511 TI(S)=TI(S)-CB:PB=PB+CB

```

```

516 PRINT#-2,""
521 PRINT#-2,TAB(5)"YEARS";TAB(1
2)"TOTAL INTEREST";TAB(28)"TOTAL
PRINCIPAL";TAB(45)"TOTAL PAYMEN
TS"
526 PRINT#-2,""
531 Z=Z/12
536 PRINT#-2,TAB(5):PRINT#-2,USI
NG"###.##";Z:PRINT#-2,TAB(12);:PR
INT#-2,USING"#####.##";TI(S):
PRINT#-2,TAB(28):PRINT#-2,USING
"#####.##";PB:PRINT#-2,TAB(45
):PRINT#-2,USING"#####.##";TP
541 CB=PB:TP=0:TI=0:PB=0:EP=0:LS
=0:GOTO 136
546 CLS:PRINT@260,"DO YOU WANT A
PRINTOUT OF..."
551 PRINT@324,"YEARLY ANALYSIS..
."
556 PRINT:PRINTTAB(11)" ( Y/N )"
561 K$=INKEY$:IF K$=""THEN561
566 IFK$="Y"THEN716ELSEIFK$="N"TH
EN581
571 ""
576 ""
581 CLS:NP=NP/2:DP=14:Z=1:H=26:Y
=1
586 POKE65495,0
591 PRINT@196,"calculating total
s..."
596 PRINT@260,"please stand by..
."
601 DI=AI/365
606 IN=DI*CB*DP
611 P=NP-IN
616 PB=PB+P
621 CB=CB-P
626 TP=TP+NP
631 TI(S)=TI(S)+IN
636 IFCB<=0THEN646ELSE641
641 Z=Z+1:GOTO606
646 TI(S)=TI(S)-CB:PB=PB+CB
651 CLS:PRINTTAB(11)"OPTION ";S
656 PRINT:PRINT"INTEREST PAID";:
PRINTTAB(21):PRINTUSING"#####
.##";TI(S)
661 PRINT"PRINCIPAL PAID";:PRINT
TAB(21):PRINTUSING"#####.##";
PB
666 PRINTTAB(21)STRING$(10,"-")
671 PRINT"TOTAL PAID";:PRINTTAB(
21):PRINTUSING"#####.##";TP
676 Z=Z/24
681 PRINT:PRINT"YEARS TO RETIRE
LOAN..";:PRINTUSING"###.##";Z
686 PRINT"1/2 NORMAL PAYMENT....
.";:PRINTUSING"###.##";NP
691 PRINT"INTEREST RATE.....
";AI;"%"
696 POKE65494,0
701 C$=INKEY$:IFC$=""THEN 701
706 IFC$="P"THEN GOSUB 1381 ELSE
711
711 NP=NP*2:TP=0:TI=0:CB=PB:PB=0
:GOTO 136
716 CLS:PRINT@264,"NOW PRINTING"
721 PRINT#-2,TAB(30)"OPTION";S
726 PRINT#-2,"YEAR";TAB(6)"INT.P
AID";TAB(18)"PRINCIPAL PAID";TAB
(35)"TOTAL PAYMENTS";TAB(51)"OUT
STANDING BALANCE"
731 NP=NP/2:DP=14:Z=1:H=26:Y=1
736 DI=AI/365
741 IN=DI*CB*DP
746 P=NP-IN
751 PB=PB+P
756 CB=CB-P
761 TP=TP+NP
766 TI(S)=TI(S)+IN
771 IF CB<=0THEN 786ELSE776
776 IFZ-H=0THEN781ELSEZ=Z+1:GOTO
741
781 PRINT#-2,Y:PRINT#-2,TAB(6);
:PRINT#-2,USING"#####.##";TI(S
):PRINT#-2,TAB(18):PRINT#-2,US
ING"#####.##";PB:PRINT#-2,TAB
(35):PRINT#-2,USING"#####.##"
;TP:PRINT#-2,TAB(51):PRINT#-2,
USING"#####.##";CB:Y=Y+1:Z=Z+1
:H=H+26:GOTO 741

```

```

786 TI(S)=TI(S)-CB:PB=PB+CB
791 PRINT#-2,"":PRINT#-2,"YEARS"
;TAB(7)"TOTAL INTEREST";TAB(23)"
TOTAL PRINCIPAL";TAB(40)"TOTAL P
AYMENTS"
796 Z=Z/24
801 PRINT#-2,"":PRINT#-2,USING"
#.#";Z:PRINT#-2,TAB(7):PRINT#-
2,USING"#####.##";TI(S):PRINT
#-2,TAB(23):PRINT#-2,USING"###
###.##";PB:PRINT#-2,TAB(40):PR
INT#-2,USING"#####.##";TP
806 NP=NP*2:CB=PB:TP=0:TI=0:PB=0
811 PRINT"HIT ANY KEY TO CONTINU
E"
816 K$=INKEY$:IFK$=""THEN816ELSE
136
821 CLS:PRINT@195,"amount of lum
p sum payment":M=12
826 INPUT LS:GOTO231
831 TP=TP+LS:CB=CB-LS:PB=PB+LS:Z
=Z+1:M=M+12:GOTO281
836 CB=CB-LS:PB=PB+LS:TP=TP+LS:Z
=Z+1:M=M+12:GOTO 501
841 CLS: PRINT@192,"amount of ex
cess payment":INPUT EP
846 GOTO 231
851 PRINT#-2,TAB(25)"LUMP SUM AM
OUNT ";:PRINT#-2,USING"#####.##"
;LS:RETURN
856 PRINT#-2,TAB(22)"AMOUNT OF E
XCESS PAYMENT ";:PRINT#-2,USING"
#####.##";EP:RETURN
861 CLS:PRINT@164,"how much will
you finance":INPUTPV
866 CLS:PRINT@164,"how many mont
hs":INPUTM
871 CLS:PRINT@163,"what is the i
nterest rate":INPUTK
876 IFK<1THEN GOTO 951
881 K=K/12:K=K/100
886 C=(1+K)^M:C=C-1
891 D=(K+1)^M:D=D*K
896 C=C/D
901 IFPV=0THENGOTO956
906 A=P/C
911 K=K*12:K=K/100
916 CLS:PRINT@96,"AMOUNT OF THE
LOAN":PRINT@118,USING"#####.##
";PV
921 PRINT@162,"NO. OF MONTHS":PR
INT@183,M
926 PRINT@226,"INTEREST RATE":PR
INT@246,K;"%"
931 PRINT@290,"MONTHLY PAYMENTS"
:PRINT@309,USING"#####.##";A
936 S$=INKEY$:IFSS$=""THEN936
941 IF S$="P"THENGOSUB 1381 ELSE
996
946 GOTO 996
951 CLS:PRINT@228,"PLEASE STATE
INTEREST RATE AS A VALUE GR
EATER THAN 1":INPUTK:GOTO881
956 CLS:PRINT@162,"what are the
monthly payments":INPUTA
961 PV=A/C:GOTO 911
966 GOSUB 1381
971 PRINT#-2,""
976 PRINT#-2,"AMOUNT OF LOAN";:P
RINT#-2,USING"#####.##";PV
981 PRINT#-2,"MONTHS REQUIRED TO
RETIRE LOAN";:PRINT#-2,M
986 PRINT#-2,"INTEREST RATE";K;:
PRINT#-2,"%"
991 PRINT#-2,"MONTHLY PAYMENTS";
:PRINT#-2,USING"#####.##";A
996 CLS:PRINT@224,"DO YOU WANT A
NOTHER CALCULATION"
1001 PRINTTAB(11)"(Y/N)"
1006 S$=INKEY$:IFSS$=""THEN1006
1011 IFS$="Y" THEN 861 ELSE 1016
1016 CB=PV:K=K/100:AI=K:NP=A:GOT
O 81
1021 CLS:PRINT@164,"DO YOU WANT
INSTRUCTIONS":PRINT@205,"( Y/N )"
"
1026 K$=INKEY$:IFK$=""THEN 1026
1031 IF K$="Y"THEN 1441 ELSE 115
6

```

```

1036 CLS:PRINT"IF YOU ARE PLANNI
NG A HOME PURCHASE..THE LOA
N CALCULATOR CAN DETERMINE YOU
R MONTHLY PAYMENTS...IF YOU
KNOW WHAT YOU CAN AFFORD PER MO
NTH,BUT DONT KNOW THE AMOUNT Y
OU CAN FINANCE TO ARRIVE AT THIS
PAYMENT.... "
1041 PRINT"THEN loan calculator
CAN HELP..."
1046 PRINT:PRINT"HIT ANY KEY TO
CONTINUE"
1051 K$=INKEY$:IFK$=""THEN1051EL
SE 1056
1056 CLS:PRINT"WHEN YOU ARE ASKE
D HOW MUCH YOU WILL FINANCE...JU
ST HIT <ENTER> YOU WILL THEN BE
ASKED THE AMOUNT OF MONTHLY
PAYMENT.ENTER WHAT YOU WANT TO
PAY PER MONTH. THE PROGRAM WILL
THEN RETURN THEAMOUNT YOU CAN FI
NANCE TO GIVE
1061 PRINT"YOU THE PAYMENTS YOU
WANT"
1066 PRINT:PRINT"PRINT"HIT ANY K
EY TO CONTINUE"
1071 K$=INKEY$:IFK$=""THEN1071EL
SE 1076
1076 CLS:PRINT"AFTER FINDING OUT
THE AMOUNT YOU CAN FINANCE. RUN
THE"
1081 PRINTTAB(7)"mortgage saving
s"
1086 PRINT"PORTION OF THIS PROGR
AM."
1091 PRINT"IT WILL SHOW THREE WA
YS YOU CAN SAVE THOUSANDS OF DOL
LARS AND MANY YEARS OFF YOUR M
ORTGAGE."
1096 PRINT"YOU CAN HAVE A YEARLY
PRINTOUT OF ANY OR ALL OPTIONS
.IT WILL SHOW,BY YEAR,INTEREST
PAID,TOTAL PAYMENT,CURRENT BALA
NCE AND YEARS PAID. IT WILL T
HEN GIVE TOTALS OF ALL ITEMS.
1101 PRINT:PRINT"HIT ANY KEY TO
CONTINUE"
1106 K$=INKEY$:IFK$=""THEN 1106E
LSE 1111
1111 CLS:PRINT"IN ORDER TO SEE A
N ON SCREEN COMPARISON OF INT
EREST PAID ON ALL OPTIONS, Y
OU MUST RUN OPTION 4 LAST."
1116 PRINT:PRINT"WHEN THERE IS N
O CURSOR ON A CALCULATED SCRE
EN YOU CAN GET A PRINTOUT BY PRE
SSING THE LETTER p ANY OTHER KEY
WILL CONTINUE THE PROGRAM"
1121 PRINT:PRINT"HIT ANY KEY TO
CONTINUE"
1126 K$=INKEY$:IFK$=""THEN1126EL
SE1131
1131 CLS:PRINT"THE AMOUNTS GIVEN
IN THIS PROGRAM SHOULD NO
T BE CONSTRUED TO BE EXACT AMOU
NTS YOU WILL PAYOR SAVE..... BUT
SHOULD BE USED ONLY AS A GUIDE T
O REPRESENT YOUR PAYMENTS AND
SAVINGS"
1136 PRINT"OPTION 2 OF THIS PROG
RAM MAY NOTBE ACCEPTABLE TO YOUR
LENDER PLEASE CHECK WITH THE
M BEFORE ATTEMPTING THIS METHO
D."
1141 PRINT"IF YOU ARE CONSIDERIN
G A HOME PURCHASE THIS IS AN A
TTRACTIVE WAY TO SET UP YOUR LO
AN PAYOFF..... AS YOU WILL SEE.
1146 PRINT"HIT ANY KEY TO CONTIN
UE"
1151 K$=INKEY$:IFK$=""THEN1151EL
SE1156
1156 CLS:PRINT"DO YOU WANT TO GO
TO THE LOAN CALCULATOR OR TO
MORTGAGE PLANNER"
1161 PRINT:PRINT"IF YOU CHOOSE T
HE CALCULATOR PORTION OF THE
PROGRAM THE LAST AMOUNTS US
ED WILL BE AUTO- MATICALLY BE EN

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```

TERED INTO THE MORTGAGE PLANNE
R"
1166 PRINT:PRINT"PRESS <C> FOR C
ALCULATOR AND <M> FOR MORTGAGE P
LANNER"
1171 S$=INKEY$:IFS$=""THEN 1171
1176 IF S$="C"THEN 861 ELSE 186
1181 FORL=1024TO1055
1186 POKEL,191:NEXTL
1191 L=1056
1196 POKEL,191
1201 L=L+32
1206 IFL=1504+32THEN1211ELSE1196
1211 FORL=1504TO1535
1216 POKEL,191:NEXTL
1221 L=1535
1226 POKEL,191
1231 L=L+32
1236 IFL=1055 THEN1241ELSE 1226
1241 FORL=107000*2:NEXTL:RETURN
1246 CLS:PRINT"DO YOU WANT TO CO
MPARE INTEREST ON ALL FOUR OPTIO
NS"
1251 PRINT:PRINTTAB(11)"(Y/N)"
1256 K$=INKEY$:IFK$=""THEN1256
1261 IF K$="Y" THEN GOTO1501ELSE
RETURN
1266 CLS:S=1
1271 TI(S)=TI(S)*100000
1276 PRINT:PRINT"OPTION";S;;PRIN
TUSING"$#####.###";TI(S)
1281 S=S+1 :IF S=5 THEN 1286 EL
S 1271
1286 IFTI(2)<=TI(3)THEN1291ELSE1
296
1291 IFTI(2)=0THEN1296 ELSE IFTI
(2)<=TI(4)THEN1301ELSE1296
1296 IFTI(3)=0THEN 1311 ELSEIFTI
(3)<=TI(4) THEN 1306 ELSE1311
1301 TI(6)=TI(1)-TI(2):GOTO1316
1306 TI(6)=TI(1)-TI(3):GOTO1316
1311 TI(6)=TI(1)-TI(4):GOTO1316
1316 PRINT:PRINT"YOU CAN SAVE ";
:PRINTUSING"$#####.###";TI(6)
1321 K$=INKEY$:IFK$=""THEN1321
1326 IFK$="P"THEN GOSUB 1381 EL
S 1331
1331 PRINT:PRINT"PRESS <R> TO RE
VIEW OPTIONS AND RUN PROGRAM AGA
IN"
1336 PRINT:PRINT"PRESS ANY OTHER
KEY TO END"
1341 K$=INKEY$:IFK$=""THEN1341
1346 IFK$="R"THEN 1366 ELSE 1351
1351 CLS:PRINT0200,"happy saving
"
1356 END
1361 GOSUB 1181
1366 S=1
1371 TI(S)=0:PB=0:Z=0:TB=0:TP=0:
LS=0:EP=0:Y=0:S=S+1:C2=0
1376 IF S=4+1 THEN 1156 ELSE 137
1
1381 ZZ=0
1386 FORXX=1024TO1535
1391 YY=PEEK(XX):ZZ=ZZ+1
1396 PP=YY AND 127
1401 IF PP=95 THENPP=PP-64
1406 PRINT#-2,CHR$(PP);
1411 IF ZZ=32 THEN PRINT#-2:ZZ=0
1416 NEXT XX
1421 RETURN
1426 PRINT"LUMP SUM AMOUNT.....
.";PRINTTAB(21);:PRINTUSING"$#
###.##";LS:RETURN
1431 PRINT"EXCESS PAYMENT.....
";:PRINTTAB(21);:PRINTUSING"$###
.###";EP:RETURN
1436 CLS
1441 CLS:PRINT"HERE'S THE BEST I
DEA TO COME ALONG IN QUITE A
WHILE: PAY OFF YOUR MORTGAGE FAS
TER, IN ORDER TO GET A QUICKER
EQUITY BUILDUP IN YOUR HOUSE.
1446 PRINT"IT USED TO COST A LIT
TLE MORE EACH MONTH TO REACH
THIS GOAL. BUT A NEW KIND OF MOR
TGAGE THAT IS JUST TAKING HOLD I
N THE U.S. CAN MAKE THE PROCESS
ALMOST PAINLESS.
1451 PRINT"FASTER MORTGAGE PAYME
NTS WILL SAVE YOU A FORTUNE IN
INTEREST RATES.
1456 PRINTTAB(10)"HIT ANY KEY"
1461 K$=INKEY$:IFK$=""THEN1461 E
LSE 1466
1466 CLS:PRINT"THE NEW WAY TO FA
STER HOME OWNERSHIP IS THROUGH A
BI-WEEKLY PAYMENT PLAN. YOU
R LOAN IS AMORTIZED AS IF I
T WERE GOING TO LAST FOR 30 YE
ARS. BUT... INSTEAD OF PAYING
ONCE A MONTH, YOU MAKE 1/2 OF
THE MONTHLY"
1471 PRINT"PAYMENT EVERY TWO WEE
KS. THIS SCHEDULE LEADS TO THE
EQUIVALENT OF 13 MONTHLY PAYMENT
S EVERY YEAR RATHER THAN THE
USUAL 12."
1476 PRINT"THIS MAY NOT SOUND LI
KE MUCH OF A CHANGE. BUT ITS EFF
ECT IN CUTTING THE TIME AND
COST OF ANYMORTGAGE IS ASTOUNDIN
G."
1481 K$=INKEY$:IFK$=""THEN1481 E
LSE 1486
1486 CLS:PRINT"THIS METHOD OF RE
PAYMENT IS option 2.YOU WILL
SEE HOW MUCH CAN BE SAVED WITH
THIS OPTION WHEN YOU COMPARE
INTEREST PAID ON ALL OPTIONS."
1491 PRINT:PRINTTAB(10)"HIT ANY
KEY"
1496 K$=INKEY$:IF K$=""THEN 1496
ELSE 1036
1501 CLS
1506 FOR L=1024 TO 1055
1511 POKE L,175:NEXT L
1516 L=1056
1521 S=1:X=0
1526 X=49
1531 POKE L,X
1536 L=L+64
1541 X=X+1
1546 IF X=53 THEN 1551 ELSE 1531
1551 FOR L=1280 TO 1311
1556 POKE L,175
1561 NEXT L
1566 FOR L=1025 TO 1280 STEP 32
1571 X=175
1576 POKE L,X:NEXT L
1581 PRINT0291,"X 1 5 10 15
20 25 30"
1586 PRINT0320,"INTEREST = X TIM
ES $10,000"
1591 S=1:X=0
1596 L=1058+X
1601 TI(S)=TI(S)/100000
1606 F=FIX(TI(S))
1611 FORL=L TO L+F
1616 POKEL,191
1621 NEXTL
1626 X=X+64
1631 S=S+1:IF S=4+1 THEN 1641 EL
SE 1596
1636 POKEL,191
1641 PRINT0384,"HIT <C> TO CONTI
NUE PROGRAM "
1646 PRINT0416,"ANY OTHER KEY WI
LL END PROGRAM"
1651 K$=INKEY$:IF K$=""THEN1651
1656 IFK$="C"THEN 1266ELSE 1351

```

continued from Page 17

#### 6) List Month Actual vs. Budget

Provides a summarized listing of account versus budget amounts for a chosen month. A difference (variance) between actual and budget is shown. Credit (-) amounts in the variance column are unfavorable (over budget) while

#### Exhibit 8

ACT <--D E S C R I P T I O N-->

- 1 HOUSE MORTGAGE
- 2 INSURANCE
- 3 BANK CARDS
- 4 ELECTRICITY
- 5 AUTO PAYMENT
- 6 GROCERIES
- 7 CLOTHING
- 8 MISCELLANEOUS

debit variances are favorable (under budget). See Exhibit 6.

#### 7) List YTD Actual vs. Budget

Provides the same information as Selection 5, except it

reflects data through a specified month. See Exhibit 7.

#### 8) List Chart of Accounts

Allows for a listing of your chart of accounts. This is a handy reference listing. See Exhibit 8.

#### 9) Return to Main Program

This option returns you to the main program, *Exptrakr*, to continue other activities.

#### 10) End Session

Select this option if you wish to terminate the program.

Although this set of programs offers various options for use in budgeting and tracking expenses, enhancements such as displaying all account detail expenditures for a year or allowing for more transactions in a month can be made. It is hoped that the programs are helpful and create an interest in expanding their usefulness. May all of your expenditures be small.

(Editor's Note: This program runs to six pages of code. In the interest of providing you with as much information as possible, we have decided to exclude the listing from the magazine.

The program of course is available on Australian Rainbow on Tape for this month. G.)

# A Simple Technique for Creating Animation

By Joseph Kolar

**A**nimation gives any CoCo graphics program a lot of pizzazz with the illusion of movement. The technique of creating animation seems beyond the capability of the newcomer to CoColand. It is not the formidable project that it appears to be.

The good news is that the beginner need not be overwhelmed by animation creation. He can do it with a minimum of artistic talent. Today, we are going to make like we are Rembrandts, and do some simple but satisfying animation. Using artistic license, we will create a "stick bird." We will take this bird, set it in flight and give it a chance to soar on our screen. We will create various stick shapes to add variety and give the appearance of graceful flight.

Look at Listing 1 and key in lines 10 and 1000. PCLS3 gives us the background blue sky upon which the bird is highlighted. Key in lines 20 to 27, the eight forms of the bird we will use in our effort to animate. They are called by the variables assigned them. The reason we use various forms of the bird is to create the illusion of a change in the bird as it wheels, soars or just flaps its wings. If we use just one shape throughout (one variable), the bird looks stiff and its flight stilted.

Key in Line 30. All the birds are displayed using the DRAW statement. The color, horizontal and vertical locations are included within quote marks. The desired bird shape is selected by picking the desired variable and added with the good old concatenation marker, '+'. Now RUN and you should be suitably unimpressed to see what is supposed to be a bird. Press BREAK and, one at a time, substitute the other variables in Line 30 to see the so-called birds in our repertoire. After you have seen them all, replace the original variable, B\$.

Keep in mind that there are many ways to develop animation. The following system is somewhat unwieldy, but

lends itself admirably for the purpose of this tutorial.

Run the program and note that we place a bird, in color C2, at both a horizontal and vertical location of 10. The bird (B\$ in this case), has the left wing "up" and the right wing in a horizontal plane. At this time, also note that in lines 40 through 350, the color (C2) is redundantly included in every DRAW statement. In Listing 1 only the first C2 in Line 30 is required to maintain the same color of the bird. CoCo knows that C2 is desired in all the subsequent DRAW lines. At a later stage in our artistic endeavors, it will be necessary to insert C2 in all of the DRAW lines in this listing. To save a lot of time and monotonous editing later on, we will put them in as we proceed.

At this stage, we will place the various-shaped birds at locations we deem either logical or interesting, one at a time, ever increasing the number of birds in the flight plan. Press BREAK, key in Line 40 and RUN. You will see a second bird form on the screen (A\$), with both wings in the "up" position. We moved it over to the right five units, to 15 on the horizontal, and 10 units down on the vertical. We now have two birds on the screen.

For the purpose of this tutorial, we will move either zero, five or 10 units from a previous location. This creates a smooth transition from one location to the next.

Press BREAK, key in Line 50 and run. The same 'V' bird is flying to the right. Comparing lines 40 and 50 in the listing, you can verify that we moved the bird 10 units to the right. Press BREAK, key in Line 60 and run. You can see the same bird heading to the right.

Don't get excited if the birds overlap on the screen. It will all be sorted out later. At this stage, we are plotting the flight path and want to see every shape and its location as we create it. This way you can locate a desired shape at the

location you feel is right. If you don't like the shape or location, it can be altered now without disturbing future additions to the flight plan. You won't have to dissect your program and wearily rearrange it later.

We are so creative that we plot our animation program directly on the screen. However, you may use graph paper if you wish to determine the shapes and locations of the birds.

Press BREAK, key in Line 70 and run. Here I promptly violated my own rule and dropped the bird, B\$, 15 units. I had a down draft in mind, which I imagined might cause the bird to drop more than usual and change directions by going five units to the right.

Press BREAK, key in Line 80 and run. Here the bird, E\$, is wheeling to the right and down; press BREAK again.

If you have difficulty viewing a shape that is superimposed over a previous shape, temporarily mask the previous line with a REM marker. RUN to see if it is what you intended, then remove the REM marker from the previous line. At this point, key in each program line one at a time, and check to see what shape you added where.

We have completed our first phase: creating, locating and displaying each bird. Now that we have created each bird in our tableau, we have to make them vanish. Beginning with the bird at Line 30 through the last one at Line 350, we will erase them. LIST 30 and add +5 to Line 30 to create the "erase" line. Thus, all program lines used to erase the birds will end in '5'. Key in 35, the line number, and copy the data appearing in Line 30 that you have on the screen changing only the digit (2) in C2 to '3'. Now run. C3 is the same color as PCLS3. The bird is still, invisible and effectively erased.

If you care to check this out, temporarily change PCLS3 to PCLS2 in Line 10 and RUN. See? Restore Line 10 to its

original state.

Press BREAK and LIST40. Create Line 45 and copy the scoop in Line 40, making the desired color change. Proceed line by line, every once in a while pausing to RUN and make sure you have erased all the birds. If some residue remains on the screen, you made a boo-boo in copying! When you check, you will be excited to see the vestiges of a bird in flight, if ever so fleetingly.

When you have finished the second phase and check out your work, you should get a fleeting glimpse of the bird in motion and end up with a blank, blue display.

Obviously, we must create pauses between the creation and disappearance of each bird so ordinary mortals can observe the flight. The third phase determines the length of time each bird is visible. We will use a pause routine to accomplish this feat: FOR Z= 1 TO X: NEXT, where 'X' is some value between 75 and 200. We will use increments of 25, so for 'X' we will use the following values: 75, 100, 125, 150, 175 and 200 to keep it simple and under control.

After you get the idea, you can substitute your values for the chosen ones in the listing to make it fly the way you want it to fly. First, let me give you the system we will use in this tutorial.

Type in LIST 30-40. We list two lines to see how far the bird moved. We note that the bird moved 10 units down and five units to the right. We compare either Line 30 or 35 to Line 40. We will place the pause line immediately following the creation line (Line 30). Each pause line will be numbered by incrementing the creation line by +1 and the erase line by +5. We will try 100 as the length of the pause. Key in 31 FOR Z=1TO100:NEXT and run. You can't see

much! Press BREAK, LIST40-50 and let's make this pause line shorter in duration by using 75. Key in 41 FOR Z=1TO75:NEXT and run, then press BREAK and LIST50-60. We'll use 100. Key in 51 FOR Z=1TO100:NEXT.

Follow the same procedure using 150 in Line 61, 100 in Line 71 and 75 at both lines 81 and 91. RUN and observe the movement. Press BREAK and adjust it to suit yourself. It is your bird! Make it fly as you would imagine it should fly. Vary the time lapse, preferably a higher figure for a large location displacement and a shorter lapse for a small movement, but do it from one line to the next in a methodical manner, ensuring that all previously determined time pause lines are satisfactory. You may compare the pauses you chose with the ones in Listing 2.

You may want the movement to be quicker so it looks even more natural. If so, lower the value of each pause line by 25 or 50 units. For that matter, you may prefer to substitute other shapes (bird variables). Be my guest! When this phase of the program is completed and all the pauses are set, you may want to change Line 1000 (1000 GOTO10).

Since many of your pause lines are repetitious, this is an ideal occasion to use GOSUB. For instance, add 400 FOR Z=1TO75:NEXT:RETURN and change lines 41, 81, 91, 141, 221, 231, 241, 251, 261, 281, 291, 301, 311, 321 and 341 to GOSUB400. You will have to put in a line, 360 GOTO10 or 360 GOTO1000, to walk around the GOSUB routine. Ideally, the GOSUB should be at the end of the program, for example, Line 2000. However, using 400 instead of 2000 saves typing one extra zero and whatever error that third zero might generate due

to typing mistakes. Naturally, you can make other GOSUB lines to accommodate frequently-used pause lines.

OK, what have we wrought? Nothing much! Just a bunch of lines flapping across the screen. But, you learned a lot quite painlessly. Let us recap:

1) A picture, design or shape must be created. It can be elaborate or as mindlessly simple as our bird. After it is created and put into a variable form, it can be called using DRAW. Alternate shapes should be created in anticipation of need, but they can be created as required and added to the list of shapes.

2) It must be located at the desired site on the screen in a color other than the background.

3) It must remain on the screen for a certain length of time.

4) It must be erased by creating the same design and in the exact location but using the background color so it appears to vanish.

5) The same picture or a variant, again created and called as a variable in a DRAW statement, can be placed in a newly selected location. Repeat steps two through four. Suppose you made a pastoral scene in the blank space reserved under the bird? Or the outline of a few buildings?

Now that you know how to make a bird fly around, you can use the same technique to produce your own creation.

As an added attraction, Listing 3 uses SOUND as a timer and has a skyline thrown in to show how to enhance the animation. You can modify your tutorial program by inserting lines 11-13, modify Line 1000 and change all pause lines to SOUND lines. If you don't care for my sounds, make up your own.



130 .....63  
END .....54

Listing 1: BIRDS

```

Ø 'LISTING1
1Ø PMODE3,1:PCLS3:SCREEN1,Ø
2Ø A$="F6E6"
21 B$="F6R6"
22 C$="R6E6"
23 D$="E6F6"
24 E$="F12"
25 F$="E12"
26 G$="R12"
27 H$="R6F6"
3Ø DRAW"C2BM1Ø,1Ø"+B$

```

```

4Ø DRAW"C2BM15,2Ø"+A$
5Ø DRAW"C2BM25,2Ø"+A$
6Ø DRAW"C2BM35,2Ø"+A$
7Ø DRAW"C2BM4Ø,35"+B$
8Ø DRAW"C2BM5Ø,4Ø"+E$
9Ø DRAW"C2BM6Ø,45"+B$
1ØØ DRAW"C2BM7Ø,45"+A$
11Ø DRAW"C2BM75,55"+A$
12Ø DRAW"C2BM85,6Ø"+A$
13Ø DRAW"C2BM9Ø,7Ø"+A$
14Ø DRAW"C2BM95,75"+C$
15Ø DRAW"C2BM11Ø,9Ø"+D$
16Ø DRAW"C2BM12Ø,9Ø"+D$
17Ø DRAW"C2BM13Ø,95"+D$
18Ø DRAW"C2BM14Ø,95"+C$
19Ø DRAW"C2BM15Ø,95"+F$
2ØØ DRAW"C2BM14Ø,8Ø"+A$
21Ø DRAW"C2BM13Ø,75"+A$
22Ø DRAW"C2BM12Ø,7Ø"+A$
23Ø DRAW"C2BM12Ø,6Ø"+A$
24Ø DRAW"C2BM12Ø,5Ø"+A$
25Ø DRAW"C2BM125,45"+B$

```

```

26Ø DRAW"C2BM12Ø,4Ø"+E$
27Ø DRAW"C2BM125,35"+E$
28Ø DRAW"C2BM13Ø,25"+A$
29Ø DRAW"C2BM135,2Ø"+A$
3ØØ DRAW"C2BM14Ø,15"+A$
31Ø DRAW"C2BM145,15"+C$
32Ø DRAW"C2BM145,1Ø"+G$
33Ø DRAW"C2BM15Ø,1Ø"+H$
34Ø DRAW"C2BM16Ø,1Ø"+D$
35Ø DRAW"C2BM16Ø,5"+D$
1ØØØ GOTO1ØØØ

```

75 .....120  
190 .....247  
270 .....52  
END .....116

Listing 2: FLIGHT 1

```

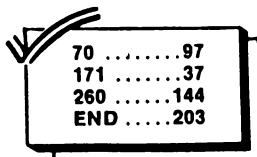
Ø '<LISTING2>
1 'CREATED BY J. KOLAR, 1985
1Ø PMODE3,1:PCLS3:SCREEN1,Ø
2Ø A$="F6E6"
21 B$="F6R6"

```

```

22 C$="R6E6"
23 D$="E6F6"
24 E$="F12"
25 F$="E12"
26 G$="R12"
27 H$="R6F6"
30 DRAW"C2BM10,10"+B$
31 FOR Z=1TO100:NEXT
35 DRAW"C3BM10,10"+B$
40 DRAW"C2BM15,20"+A$
41 FOR Z=1TO75:NEXT
45 DRAW"C3BM15,20"+A$
50 DRAW"C2BM25,20"+A$
51 FOR Z=1 TO 100:NEXT
55 DRAW"C3BM25,20"+A$
60 DRAW"C2BM35,20"+A$
61 FOR Z=1 TO 150:NEXT
65 DRAW"C3BM35,20"+A$
70 DRAW"C2BM40,35"+B$
71 FOR Z=1TO100:NEXT
75 DRAW"C3BM40,35"+B$
80 DRAW"C2BM50,40"+E$
81 FORZ=1TO75:NEXT
85 DRAW"C3BM50,40"+E$
90 DRAW"C2BM60,45"+B$
91 FOR Z=1TO 75:NEXT
95 DRAW"C3BM60,45"+B$
100 DRAW"C2BM70,45"+A$
101 FOR Z=1TO150:NEXT
105 DRAW"C3BM70,45"+A$
110 DRAW"C2BM75,55"+A$
111 FOR Z=1TO125:NEXT
115 DRAW"C3BM75,55"+A$
120 DRAW"C2BM85,60"+A$
121 FOR Z=1 TO 125:NEXT
125 DRAW"C3BM85,60"+A$
130 DRAW"C2BM90,70"+A$
131 FOR Z=1TO75:NEXT
135 DRAW"C3BM90,70"+A$
140 DRAW"C2BM95,75"+C$
141 FOR Z=1TO175:NEXT
145 DRAW"C3BM95,75"+C$
150 DRAW"C2BM110,90"+D$
151 FOR Z=1TO100:NEXT
155 DRAW"C3BM110,90"+D$
160 DRAW"C2BM120,90"+D$
161 FOR Z=1TO100:NEXT
165 DRAW"C3BM120,90"+D$
170 DRAW"C2BM130,95"+D$
171 FOR Z=1 TO 125:NEXT
175 DRAW"C3BM130,95"+D$
180 DRAW"C2BM140,95"+C$
181 FORZ=1TO125:NEXT
185 DRAW"C3BM140,95"+C$
190 DRAW"C2BM150,95"+F$
191 FOR Z=1TO 175:NEXT
195 DRAW"C3BM150,95"+F$
200 DRAW"C2BM140,80"+A$
201 FOR Z=1TO125:NEXT
205 DRAW"C3BM140,80"+A$
210 DRAW"C2BM130,75"+A$
211 FOR Z=1TO100:NEXT
215 DRAW"C3BM130,75"+A$
220 DRAW"C2BM120,70"+A$
221 SOUND89,2
225 DRAW"C3BM120,70"+A$
230 DRAW"C2BM120,60"+A$
231 SOUND89,2
235 DRAW"C3BM120,60"+A$
240 DRAW"C2BM120,50"+A$
241 SOUND89,2
245 DRAW"C3BM120,50"+A$
250 DRAW"C2BM125,45"+B$
251 SOUND89,2
255 DRAW"C3BM125,45"+B$
260 DRAW"C2BM120,40"+E$
261 SOUND89,2
265 DRAW"C3BM120,40"+E$
270 DRAW"C2BM125,35"+E$
271 SOUND125,2
275 DRAW"C3BM125,35"+E$
280 DRAW"C2BM130,25"+A$
281 SOUND89,2
285 DRAW"C3BM130,25"+A$
290 DRAW"C2BM135,20"+A$
291 SOUND89,2
295 DRAW"C3BM135,20"+A$
300 DRAW"C2BM140,15"+A$
301 SOUND89,2
305 DRAW"C3BM140,15"+A$
310 DRAW"C2BM145,15"+C$
311 SOUND 89,2
315 DRAW"C3BM145,15"+C$
320 DRAW"C2BM145,10"+G$
321 SOUND89,2
325 DRAW"C3BM145,10"+G$
330 DRAW"C2BM150,10"+H$
331 FOR Z=1TO125:NEXT
335 DRAW"C3BM150,10"+H$
340 DRAW"C2BM160,10"+D$
341 FOR Z=1TO 75:NEXT
345 DRAW"C3BM160,10"+D$
350 DRAW"C2BM160,5"+D$
351 FOR Z=1TO200:NEXT
355 DRAW"C3BM160,5"+D$
1000 GOTOL0

```



Listing 3: FLIGHT 2

```

0 '<LISTING3>
1 ' CREATED BY J. KOLAR, 1985
10 PMODE3,1:PCLS3:SCREEN1,0
11 DRAW"C1BM0,140R40D10R10U90R10
D30R50D50R40U40R10D40R10U90R40D1
00R10U10R10D10R10U40R20BD50L255"
12 PAINT(5,145),2,1
13 PAINT(5,190),1,1
20 A$="F6E6"
21 B$="F6R6"
22 C$="R6E6"
23 D$="E6F6"
24 E$="F12"
25 F$="E12"
26 G$="R12"
27 H$="R6F6"
30 DRAW"C2BM10,10"+B$
31 SOUND125,3
35 DRAW"C3BM10,10"+B$
40 DRAW"C2BM15,20"+A$
41 SOUND 89,2
45 DRAW"C3BM15,20"+A$
50 DRAW"C2BM25,20"+A$
51 SOUND125,3
55 DRAW"C3BM25,20"+A$
60 DRAW"C2BM35,20"+A$
61 SOUND159,2
65 DRAW"C3BM35,20"+A$
70 DRAW"C2BM40,35"+B$
71 SOUND125,3
75 DRAW"C3BM40,35"+B$
80 DRAW"C2BM50,40"+E$
81 SOUND89,2

```

```

85 DRAW"C3BM50,40"+E$
90 DRAW"C2BM60,45"+B$
91 SOUND89,3
95 DRAW"C3BM60,45"+B$
100 DRAW"C2BM70,45"+A$
101 SOUND159,2
105 DRAW"C3BM70,45"+A$
110 DRAW"C2BM75,55"+A$
111 SOUND133,2
115 DRAW"C3BM75,55"+A$
120 DRAW"C2BM85,60"+A$
121 SOUND133,2
125 DRAW"C3BM85,60"+A$
130 DRAW"C2BM90,70"+A$
131 SOUND89,2
135 DRAW"C3BM90,70"+A$
140 DRAW"C2BM95,75"+C$
141 SOUND89,2
145 DRAW"C3BM95,75"+C$
150 DRAW"C2BM110,90"+D$
151 SOUND125,2
155 DRAW"C3BM110,90"+D$
160 DRAW"C2BM120,90"+D$
161 SOUND125,2
165 DRAW"C3BM120,90"+D$
170 DRAW"C2BM130,95"+D$
171 SOUND125,2
175 DRAW"C3BM130,95"+D$
180 DRAW"C2BM140,95"+C$
181 SOUND133,2
185 DRAW"C3BM140,95"+C$
190 DRAW"C2BM150,95"+F$
191 SOUND170,2
195 DRAW"C3BM150,95"+F$
200 DRAW"C2BM140,80"+A$
201 SOUND133,2
205 DRAW"C3BM140,80"+A$
210 DRAW"C2BM130,75"+A$
211 SOUND 125,2
215 DRAW"C3BM130,75"+A$
220 DRAW"C2BM120,70"+A$
221 SOUND89,2
225 DRAW"C3BM120,70"+A$
230 DRAW"C2BM120,60"+A$
231 SOUND89,2
235 DRAW"C3BM120,60"+A$
240 DRAW"C2BM120,50"+A$
241 SOUND89,2
245 DRAW"C3BM120,50"+A$
250 DRAW"C2BM125,45"+B$
251 SOUND89,2
255 DRAW"C3BM125,45"+B$
260 DRAW"C2BM120,40"+E$
261 SOUND89,2
265 DRAW"C3BM120,40"+E$
270 DRAW"C2BM125,35"+E$
271 SOUND125,2
275 DRAW"C3BM125,35"+E$
280 DRAW"C2BM130,25"+A$
281 SOUND89,2
285 DRAW"C3BM130,25"+A$
290 DRAW"C2BM135,20"+A$
291 SOUND89,2
295 DRAW"C3BM135,20"+A$
300 DRAW"C2BM140,15"+A$
301 SOUND89,2
305 DRAW"C3BM140,15"+A$
310 DRAW"C2BM145,15"+C$
311 SOUND 89,2
315 DRAW"C3BM145,15"+C$
320 DRAW"C2BM145,10"+G$
321 SOUND89,2

```

continued on Page 41

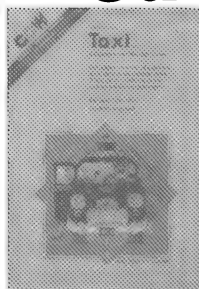


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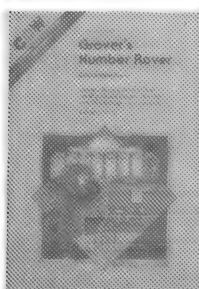


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# A Disk Tinkerer's Device

By Martin H. Goodman

There was an excellent article in the December 1985 RAINBOW, "Zapping with Confidence," Page 118 by Jeffry Dwight, that provided a well-designed "disk zap" utility. Now you can have an easy means to examine and modify disks. In this article I will try to aid such hardy tinkerers by discussing some aspects of just what you will see when you look at your disks. Some of this material is explained in the Radio Shack Disk Extended BASIC manual in Chapter 11. Some of the material, however, is not given there, especially the information on specific file structure.

As a bonus, I'll provide you with a utility. Called *Analyzer*, it automatically gathers up the widely separated information on just where given directory files are on your disk and prints it out in a neat fashion. *Analyzer* can be used in conjunction with any disk editor, such as the one mentioned above.

**Note 1:** There may be some confusion about what number (zero or one) is the first number in a given sequence. The first sector on a track is numbered one, yet the first track on the disk is numbered zero. The first byte in the directory entry is called "byte zero." The first granule is called granule number zero. These are arbitrary conventions. They are not all consistent with each other, and are a pain to remember . . . but remember them a hacker must!

**Note 2:** When referring to the data on the disk, I'll denote it in two different forms. When I say the first 11 bytes contain the filename and extension, I mean that the data is there in ASCII code. However, when I say the File Type flag byte will be 0, 1, 2 or 3, I am indicating the Hex value of that byte. When I later refer to the value of a byte in the Granule Allocation Table, I'll also be referring to its Hex value.

The letter 'A' in ASCII is represented as Hex 41. Most disk zappers offer the option of displaying a sector in either

Hex or ASCII. The one published in the December RAINBOW had even more options (decimal and binary) for how to display the data from the disk. The best disk zappers use a technique to display at the same time both the ASCII value and the Hex value of at least a selected byte in the sector, if not some or all of the sector. Some disk zappers (*VIPs*, for example) display "screen code" values of the sector. This is vaguely like an ASCII display, but the data is represented somewhat differently. With such zappers, the ASCII/Hex options need to be used. In this article, when I make reference to text I'm talking ASCII, but when I specify to numeric information I am talking Hex.

**Note 3:** I will assume we are considering only normal Radio Shack/Microsoft Disk Extended BASIC files here. What follows is not relevant directly to OS-9, copy-protected material or to noncopy-protected, but also non standard format disks, such as some new Radio Shack games, the new Infocom games and *Graphicom* or *WEFAX* picture disks.

**Note 4:** I will assume you are familiar with the fundamental divisions of data on a disk: the 35 tracks and the 18 256-byte sectors that are standard for Radio Shack's Disk Operating System. The Radio Shack Disk Extended BASIC manual is quite clear on this matter. I will also assume you understand that a "granule" consists of nine sectors on the disk, thus is 2¼K in size and can occupy either the first or the last nine sectors (numbered 1 through 9 or 10 through 18) on a given track. Every track except Track 17 (the directory track) consists of two granules. The directory track is excluded from granule notation. Therefore, Track 0, Sector 1 is the first sector in granule number 0, Track 16, Sector 18 is the last sector in Granule 33 and Track 18, Sector 1 is in Granule 34.

**Note 5:** Most of the time I will use Hex notation, but sometimes I will use decimal. Thus, when I refer to Track 17,

I am talking decimal. Whenever I use Hex, I'll specify it by writing the word "Hex" or by preceding the number with a dollar sign (\$).

These notes may seem tedious, but hopefully they will help the novice get past some of the conventions that longtime hackers often accept and understand without thinking about them, yet are sometimes confusing to the newcomer.

## Directory Structure

When you type DIR, you see a listing of filenames, extensions and then a number, a letter and another number. The first number displayed is the File Type, the letter is the ASCII flag and the last number is the number of granules in that file. Everything except for the information on how many granules there are in the file is directly recorded in the directory entry.

The directory starts on Track 17 (Hex \$11), Sector 3. Each entry is 32 (Hex \$20) bytes long, of which only the first 16 (Hex \$10) bytes are used. The remaining 16 bytes are "reserved for future use" by Microsoft. Therefore, one sector can hold up to eight directory entries. If the directory has more than eight files on it, then more sectors (Track 17, sectors 4, 5, 6, etc.) are used. Let's look at Track 17, Sector 3.

## Bytes \$00 through \$0A: Filename and Extension

As can be learned from reading Chapter 11 of the Radio Shack manual, filenames in the directory are placed on Track 17, Sector 3 and up. The first eight bytes of the entry are the filename, the next three are its extension. These 11 bytes normally contain ASCII characters. Files that were killed will have the first byte in their name changed to Hex 0.

## Byte \$0B: File Type Flag

The next one is the File Type flag. This byte equals 00 for tokenized BASIC

programs. It equals Hex 01 for what the Radio Shack manual calls "BASIC data files," or what you will encounter as "ASCII BASIC" files, or as with many word processors and editor/assemblers, ASCII text files. It equals Hex 02 for machine language programs. The manual says this byte equals Hex 03 for "text editor source files." This File Type is rarely encountered, except by users of *Color Scripts*. To those, I suggest buying *Telewriter* and *Telepatch* or *VIP Writer* or *Elite Word*. You'll have a much better word processor and won't have to worry about text editor source files.

#### Byte \$0C: ASCII Flag

The ASCII flag follows the File Type flag. This single byte is set to zero if the file is in binary format, and set to Hex FF if the file is in ASCII format. Tokenized BASIC is a kind of binary File Type; so is a machine language program. Thus, both of those tend to have the ASCII flag set to zero. ASCII text files (File Type flag = 1) have their ASCII flag set to Hex FF.

#### Byte \$0D: First Granule

This is the number of the first granule used for the file.

#### Bytes \$0E and \$0F: Number of Bytes in Last Sector

Byte \$0E is the high order byte, and is either zero or one — most of the time

it is zero. If one, the next byte is zero, and 256 bytes in use (a full sector) are specified. Byte 15 varies from one through FF to signify from one through 255 bytes used in the last sector of the file. Bytes \$10 through \$1F are "reserved" from back in 1981 for "future use." They have never been used.

Note here that while bytes Hex 0D, 0E and 0F provide some information about where the file resides on the disk and how far it extends, they leave out a lot! They give no clue, in and of themselves, as to how many granules there are in the file or of how many sectors are used in the last granule of the file. To find that out, you have to move over to Track 17, Sector 2, called the Granule Allocation Table, or GAT.

#### The GAT

The GAT occupies Track 17, Sector 2. Actually, only the first 68 bytes of Track 17, Sector 2 constitute the GAT. The disk manual incorrectly states that the remaining bytes in that sector will be zero. Anyone who's ever looked at a disk with a zapper knows this is not true. Indeed, due to some sloppy code in Disk BASIC, copies of pieces of the directory itself wind up in the space beyond the 68th byte of Track 17, Sector 2. This little idiosyncrasy had to be corrected by authors of Disk BASIC modifications who were implementing support for 40- and 80-track drives, but that's another story. Suffice it to say

here that in a normal Disk BASIC disk, the first 68 bytes of Track 17, Sector 2 are the GAT and the remaining bytes are "garbage."

The first byte in the GAT is "byte number zero." Each byte in the GAT corresponds to the status of a given granule on the disk. That status is encoded as follows: If the GAT byte is equal to \$FF, then the corresponding granule is available for new files. On a blank disk this is a blank (all \$FF) granule; on an often-used disk, which has had files killed and other files written to it, that granule might contain some data from a previously killed file. In either case, the granule is flagged as available for new files.

If a byte in the GAT is equal to a number from zero through 67 (\$0 through \$43), it means that the granule is occupied by a given directory file, that this granule is not the last granule in the file, and the next granule in the file is the granule number corresponding to the number in that byte. As a result, if the directory entry says the first granule in a file is Granule \$1E and Byte \$1E in the GAT reads Hex 1F, that means granule \$1F is the next granule in the file, and Byte \$1F of the GAT must now be looked at to learn more about where the file resides.

If the byte in the GAT reads \$C1 through \$C9, it means the corresponding granule is the last granule in the file, and the number of sectors in the granule that actually belong to the file is the low order Hex digit of the number in the GAT byte. That is, if we look at Byte \$1F from the example of the last paragraph and find it contains \$C4, it means the file in question occupies a total of two granules, granules 1E and 1F, and Granule 1F actually has only the first four of its sectors used for the file (the remaining five would be wasted).

Note that the smallest file in Disk BASIC *must* occupy a whole granule, even if it is only one byte long. The rest of the granule in question is wasted. Note that if a GAT byte is equal to any number *besides* \$FF, 00 through \$43, or \$C1 through \$C9, it means the GAT itself has an error in it! The Disk BASIC manual alleges that \$C0 is a valid code for a GAT byte, but I can see no use for that value. (If a reader can explain to me the significance of a \$C0 GAT byte value, I'd appreciate it.) For now, I can only assume the Disk BASIC manual is in error on this matter.

To fully know exactly where the file ends, we now need to hop back to look at the directory entry for the number of bytes in the last sector of the file that

#### Sample Run

```
* INDICATES A KILLED FILE WHEN IN FRONT OF FILE NAME
* INDICATES INVALID GAT ENTRY IN GAT LISTING
KILLED FILES THAT ARE NOT LISTED AS 'SCRUNCHED GAT' HAVE MOST LIKELY
BEEN WRITTEN OVER BY A NEW FILE AND ARE REALLY LOST!
```

```
DIRECT1 /BAK BASIC data file    ASCII
00,01,02,03,04,05,06
2 = # OF SECTORS IN LAST GRAN
2 = # OF BYTES IN LAST SECTOR
```

```
DIRECT2 /BAK BASIC data file    ASCII
07,08,09,0A
6 = # OF SECTORS IN LAST GRAN
3B = # OF BYTES IN LAST SECTOR
```

```
DISKANAL/BAK BASIC program      BINARY
0B
9 = # OF SECTORS IN LAST GRAN
FF = # OF BYTES IN LAST SECTOR
```

```
DIRECT1 /TXT BASIC data file    ASCII
0C,0D,0E,0F,10,11,12
2 = # OF SECTORS IN LAST GRAN
2 = # OF BYTES IN LAST SECTOR
```

```
DIRECT2 /TXT BASIC data file    ASCII
13,14,15,16
6 = # OF SECTORS IN LAST GRAN
3B = # OF BYTES IN LAST SECTOR
```

```
DISKANAL/BAS BASIC program      BINARY
17
9 = # OF SECTORS IN LAST GRAN
FF = # OF BYTES IN LAST SECTOR
```

are actually used. You now can see that the specification of what bytes on the disk correspond to a given file is smeared out between the directory entry for that file and the GAT. In the GAT, the file size has to be determined by tracking down the file from GAT byte to GAT byte, until the end of what programmers call the "linked list" of bytes is reached. And finally, after finding the last granule and last sector in that granule, one has to go back to the directory entry to find where the last used byte is in the last sector.

What a mess! Why did they do it that way? Despite the mess, there is some method to this madness. Grouping all the information concerning which granules are used and which are not into one single block, they facilitate keeping track of available space on the disk and make killing of old files easier to do. Though there are some ways in which the scheme is needlessly complex, it actually makes more sense than it seems to upon first glance after you start considering how disk operating systems and file managers have to be written.

### Killed Files

When you kill a file using Disk BASIC, the actual file data is not immediately destroyed. What happens is the first byte in the name of the file in the directory is set to zero, and all bytes in the Granule Allocation Table, which correspond to bytes in that file, are set to \$FF (= available). Thus, if you kill a file, all data in the file remains on the disk. Only the information in the GAT needed to find such data is destroyed by the KILL command itself.

Of course, if you try to SAVE any new data to a disk after killing a file, you may end up writing over granules that were previously a part of the killed file, or even writing over the old killed directory entry as well. At that point, the file data in the killed file is completely destroyed. But, if you have merely killed a file and then want to restore it, such restoration is possible, though often tedious.

As you add files to a fresh, formatted disk, Disk BASIC is inclined to assign granules to each new file in a fashion that starts on one side of the directory and tends to alternate on either side of the directory track. Therefore, files under Disk BASIC tend to get assigned near the middle of the disk and grow towards both the center and the outer edge.

However, some disk utilities (such as Spectrum Projects' *Directory Utility*) assign granules sequentially from Granule 0 to Granule 68; disks that have had

many files written to them, then erased, then others written to them, tend to have the granules that compose a given file scattered all over the disk. This can make reconstruction of a big killed file on such a disk very difficult.

### File Structure

Now that you know how to find a given file, from its first to last byte on the disk, I'll explain what you can expect to see in the three most commonly encountered Disk BASIC files.

#### ASCII

ASCII text files ("BASIC text files") are the easiest of all to understand. These files have the File Type flag set to one and the ASCII flag set to \$FF. They are almost totally "raw" data — just byte after byte of information, usually (though not necessarily) ASCII text. The only thing special about them is the last byte in the file is Hex 1A (control Z). This is the flag that marks the end of an ASCII text file. Within the file the bytes are typically less than a Hex value of \$80, but are not required to be so. Thus, the only special "structure" such a file has is that it will not have any \$1A's in it until the last byte of the file.

#### Tokenized BASIC

Tokenized BASIC files are a kind of binary file. They have a File Type flag of zero and an ASCII flag of zero as well. Looking at them in ASCII, you will be able to recognize all the text that is in the BASIC program, but all BASIC key words are encoded ("tokenized") into one or two bytes. Line numbers do not appear as ASCII, but as two Hex bytes.

For example, the line 257 PRINT "ABC" appears in the file as the following sequence of bytes: 00 (a line delimiter), 01 01 (the two-byte Hex value for 257 decimal) followed by Hex 80 (the BASIC token code for PRINT), then Hex 22 41 42 43 22, the ASCII codes for "ABC". Because no BASIC token is set to 00, and 00 is a nul (not used to encode ASCII letters and symbols), you will never find inside the tokenized BASIC file more than two 00 bytes in a row.

However, at the end of the file, you will find three 00 bytes. This is BASIC's "end of file flag." If you are in the process of reconstructing a disk after losing the GAT on it (an utterly thankless task . . . let me tell you!), your reconstruction of a given BASIC file is aided by your search for the sector with BASIC code and three 00 bytes.

Occasionally, you might encounter

what appears to be a normal BASIC file that has two sets of three 00 bytes in it. This most likely is an especially prepared "end packed" BASIC file, made up by programmers to stuff machine language code invisibly at the end of a BASIC file. Such files are not normal BASIC files and have been "foxed with" by the programmer.

### Machine Language Files

These are by far the most complicated files of all. This is due to the provision Microsoft made for "segmented" binary files. That is, an ML file on a disk (unlike its counterpart on a tape) can consist of several segments that load in different areas of memory. Let's start with the description of a non-segmented ML file, then go on from there.

#### Non-segmented ML Files

The SAVEM command generates non-segmented ML files. Note that the SAVEM command cannot generate a segmented ML file; those are created using various editor/assemblers or by foxing with the file as it resides on the disk using a disk zapper. Such non-segmented ML files (actually they are segmented files that have only one segment) begin with a 00 byte. This is followed by two bytes that specify number of ML data bytes, then by two more bytes that specify where the ML data is to start loading into memory. This five-byte "header" is followed by the ML data itself. At the end of the file is a five-byte ending sequence, consisting of an \$FF byte, two bytes of 00 each, then two bytes that specify the execute address of the file.

For example, if you made a file using SAVEM "TEST" &H4321, &H4324, &H4322, and if \$4321 through \$4324 contain the Hex values A1, B2, C3 and D4 at the time you save the file, it appears on the disk (in Hex) as follows: 00 00 04 43 21 (the five-byte header with the 00 flag byte, the length of the file as \$0004 and the start address of \$4321), followed by A1, B2, C3, D4 (the actual data in the file itself), followed by the end five bytes of FF, 00, 00, 43 and 22.

Note carefully that the end address is not specifically stored as such on the disk in the file header. It must be calculated from the start of load address and the file length. Also note that you must track the file down to its end before you can tell what its execute address is.

#### Segmented ML Files

Segmented ML files are very similar, but after the first segment, instead of



having an FF 00 00 (execute address) five-byte end flag, they have another header, specifying more data to be loaded elsewhere in memory. There is no limit (other than the memory of the CoCo and the size of the disk) on how many segments such a file can have, so it is possible to create an ML file that loads single bytes all over the memory of the CoCo. In these segmented files the end is recognized by the presence of the FF end flag followed by the 00 00 (execute address) five-byte final block. Thus, a segmented ML file can have lots of start and end addresses, though it can only have one execute address.

This segmented structure can be a bit confusing, but it is very convenient for assemblers! And, it is helpful when you need to make a program that loads stuff in differing and widely separated areas of memory. Such segmented files are easily created with *EDTASM* and with *Macro 80C* (and probably most other editor/assembler packages) using more than one ORG statement in the source code. Indeed, some assemblers that assemble directly to disk, like *Macro 80C*, create segmented files even when assembling source code that is not multiple ORGed. In such cases, the end address of one segment will be seen to be one less than the start address of the next.

## References

*Disk BASIC Unravelled*, published by Spectral Associates, is the bible for ML disk hackers. Indeed, I'd go so far as to say that if you do any assembly language hacking using Disk BASIC, you need to buy the three-volume *BASIC Unravelled* (cost is about \$50). This set has fully commented disassemblies of all versions of the CoCo ROMs, gobs of information about the RAM-base page and such, stuff on file formats, BASIC routine entry points, and the like. It is what Microsoft and Tandy should have published the day they released the CoCo on the market. Spectral Associates and the unnamed ML hacker(s) who compiled this set deserve the thanks of all CoCo users.

The *Disk Extended BASIC Manual* comes with your Radio Shack disk Drive 0. This manual can be ordered separately, although only the few pages in Chapter 11 are of relevance to what is written here.

## The Disk Analyzer Program

The following simple BASIC program automatically searches out all the information needed to find every byte in a given valid file on a Disk BASIC disk. It dumps that information to a printer; you can also have it go to the screen by changing Line 50 from D=-2 to D=0. If

you do this, you'll want to add some kind of pause feature as the data otherwise scrolls by too quickly to read. Just load the program, type RUN, put the disk you want to analyze in Drive 0, make your printer ready and press any key. All text is printed in ASCII characters and all numeric values are printed in Hex.

*Analyzer* prints four lines of information about each file on your disk.

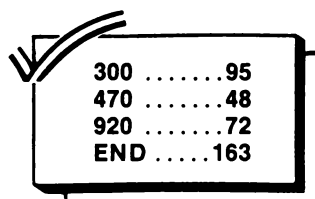
First line: Filename, extension, File Type flag byte status, ASCII flag status (an asterisk [\*] precedes any killed files on your disk that this *Analyzer* will see and list).

Second line: The numbers of all the granules that compose the file, from the first to the last. If invalid granule numbers are detected, the program indicates this by a '\*' and/or by printing in the next line "scrunched GAT!".

Third line: The number of sectors in the last granule.

Fourth line: The number of bytes in the last sector.

This program gathers together all the widely separated data into one table for you to refer to when you are wandering around your disk using a disk zapper. Note that *Analyzer* does some testing for messed up entries, but on a disk with blown directory entries it won't be of much use. □



300	.....95
470	.....48
920	.....72
END	.....163

### The listing: ANALYZER

```

10 CLEAR 2000
20 DIM G(69)
25 CLS:PRINT"(C) MARTY GOODMAN 1
985":PRINT
30 PRINT"DIRECTORY ANALYZER":PRI
NT:PRINT"PREPARE PRINTER":PRINT:
PRINT"HIT ANY KEY TO CONTINUE"
40 IF INKEY$="" THEN GOTO 40
50 D=-2
70 PRINT#D,"* INDICATES A KILLED
FILE WHEN IN FRONT OF FILE NAME
"
80 PRINT#D,"* INDICATES INVALID
GAT ENTRY IN GAT LISTING"
90 PRINT#D,"KILLED FILES THAT AR
E NOT LISTED AS 'SCRUNCHED GAT'
HAVE MOST LIKELY"
92 PRINT#D,"BEEN WRITTEN OVER BY
A NEW FILE AND ARE REALLY LOST!"
95 PRINT#D,"":PRINT#D,""
100 REM READ IN GAT
110 DSKI$ 0,17,2,A$,B$
120 FOR N=1 TO 68
130 G(N)=ASC(MID$(A$,N,1))
140 NEXT N
200 REM ANALYZE DIRECTORY

```

```

210 S=3
250 DSKI$ 0,17,S,A$,B$
300 REM MAIN LOOP
305 IF LEN(A$)=0 THEN :GOTO 5000
307 K=0
310 T=1:GOSUB 2000:IF E$=CHR$(&H
FF) THEN GOTO 9000
320 IF ASC(E$)<>0 THEN GOTO 350
325 K=1
335 PRINT#D,"* ";
350 T=8:GOSUB 1000:PRINT#D,E$;:P
RINT#D,"/";
360 T=3:GOSUB 1000:PRINT#D,E$;
370 T=1:GOSUB 1000
375 E=ASC(E$)
380 IF E=0 THEN GOTO 410
385 IF E=1 THEN GOTO 420
390 IF E=2 THEN GOTO 430
395 IF E=3 THEN GOTO 440
400 PRINT#D," BAD FLAG BYTE ";:
GOTO 450
410 PRINT#D," BASIC program ";:
GOTO 450
420 PRINT#D," BASIC data file";:
GOTO 450
430 PRINT#D," Mach Lang prog";:
GOTO 450
440 PRINT#D," Txt Ed src file";
450 PRINT#D," ";:T=1:GOSUB 100
0:E=ASC(E$)
460 IF E=0 THEN GOTO 480
465 IF E=255 THEN GOTO 490
470 PRINT#D," *BAD* ":GOTO 500
480 PRINT#D," BINARY":GOTO 500
490 PRINT#D," ASCII "
500 REM ANALYZE GAT ENTRIES
510 T=1:GOSUB 1000:E=ASC(E$)
515 COMMA=0
520 REM GAT LOOP
525 GOSUB 3000

```

```

530 IF V=0 THEN PRINT#D," *:GOT
O 890
540 IF V=2 THEN GOTO 800
545 IF COMMA=0 THEN GOTO 550
547 PRINT#D," ";
550 G$="0000":G$=G$+HEX$(E):G$=R
IGHT$(G$,2):PRINT#D,G$;
560 COMMA =1
570 E=G(E+1):GOTO 520
800 REM CHECK SECTORS USED IN
LAST GRAN
810 PRINT#D,"":PRINT#D,E AND &H0
F;" = # OF SECTORS IN LAST GRAN
"
820 GOTO 900
890 PRINT#D,"SCRUNCHED GAT!"
900 REM CHECK BYTE COUNT IN LAST
SECTOR AND LOOP
910 GOSUB 1000
915 B=ASC(E$):IF B>1 THEN GOTO 9
80
920 T=1:GOSUB 1000
925 BC=256*B+ASC(E$):IF BC>256 T
HEN GOTO 980
930 PRINT#D,HEX$(BC);" = # OF BY
TES IN LAST SECTOR"
940 T=16:GOSUB 1000
945 PRINT#D,""
950 GOTO 300
980 PRINT#D,"BAD BYTE COUNT ENTR
Y!":GOTO 940
1000 REM TRIM OFF LEFT AND GET
SUBSTRING
1005 E$=LEFT$(A$,T)
1010 A$=RIGHT$(A$,LEN(A$)-T):RET
URN

```

continued on Page 41

# VARLIST:

## A Quick and Easy Way to List Program Variables

By Hans Schulz

**V***arlist*, a utility program that lists all variables, will lend some help with those pesky problem programs that you just can't get to work properly.

Let's look at an example. I once had a program with a variable called LNC (for "Line Count"); it also had another variable named LND (for "Line Description"). The program just didn't work as anticipated. Of course, in hindsight I realized the error of my ways: Only the first two characters are significant in a variable name. The program treated LNC and LND as the same variable!

Now, if I only had a utility tool that could tell me all the lines containing LNC and LND. I didn't have such a tool, and it took me an agonizingly long time to go through every line of the program to change one of the variable names so it was different from the other.

I decided then that someday I would write such a utility program. *Varlist* is the result, and I would like to share it with other CoCo friends. It lists all the numbers of the lines in which variables appear; in fact, if a variable appears twice, it is listed twice. In addition, it also highlights all the jump statements, i.e., GOTO, GOSUB, THEN and ELSE.

### Do You Like BASIC's Beauty?

This program is written entirely in BASIC. As you can imagine, it does not exactly race through the target program, but it lets you know where it is at all times. In the interest of preserving some processing speed, I have kept the REMarks to a bare minimum and have eliminated unnecessary spaces wherever possible. A program line without spaces between BASIC statements and variable names may look strange at first sight,

but you will get the drift of it.

### Are You in a Hurry?

POKE 65495,0 will increase your processing speed, but if you are really impatient, insert lines 50001 and 50601 into *Varlist* for additional speed (see Listing 2). However, you lose the screen display during this speed up.

### Do You have Enough Memory?

*Varlist* uses approximately 9,000 bytes (9K) of RAM. The program changes the standard PCLEAR4 when you first turn on the CoCo to PCLEAR1, which only reserves one page of graphics memory (1,536 bytes). If you have a lengthy target program you may have to free up some additional memory to fit both *Varlist* and your program into the available RAM space. To get at the extra 1,536 bytes, you have to perform the equivalent of a PCLEAR0, which, as you may know, is not a valid BASIC command. It can be summarized as follows: When you first power up your CoCo, type POKE &H19,6:NEW and press ENTER. In this case, you should also remove the PCLEAR1 statement from Line 50010.

### How do You get the Program to Work?

First key in *Varlist* and CSAVE a copy of it, then make sure there are no typing errors by testing it with RUN 50000. It will list the variables in the test program (lines 10 through 90). Correct typing errors, if any, and CSAVE a corrected copy of *Varlist*. Now delete lines 10 through 90.

Make sure the program for which you want to produce the list of variables does not have any line numbers greater than 49999 and, if necessary, renumber it. Merge your program with *Varlist*.

Now type RUN 50000 and press ENTER. The screen will display the line numbers of your program, which *Varlist* is scrutinizing as it steps through the program line by line.

### How does *Varlist* Work?

Line 50010 reserves 1,500 bytes of memory for string variables and reserves space for 500 variable names and 500 line numbers; it also releases three pages of graphics memory. (When you turn on your CoCo it automatically PCLEARs four graphics pages.) Then the screen is cleared.

Line 50030 finds the starting address of your BASIC program in memory, regardless of whether you have a 16K or 32K CoCo. (This may be useful for future reference.)

Line 50040 initializes the variable PO (the pointer address of the beginning of the next line) and variable LI (the current line number being worked on). Line 50570, processed in the GOSUB statement, displays the line number being examined on the screen. If the line number is greater than 49999 then the program has reached *Varlist* and the end of your target program, in which case all variables have been found and the list will be displayed on the screen starting at Line 50600.

As an aid to the general understanding of *Varlist*, I let it generate a list of the variables used in the *Varlist* program (see Sample Output, Table 1). I have also prepared a shortened list of the variables, where each variable appears only once, and have sorted the variables in alphabetical order (see Table 2).

The GOSUB 50520 in Line 50060 reads the next character (in ASCII format) from the memory location where your



**Table 1**  
**Sample Output:**  
**Variables and Jumps in Varlist**

```

50010 LA$(SUB)
50010 LR(SUB)
50030 N
50040 gosub 50550
50040 goto 50090
50060 gosub 50520
50070 C
50070 N
50070 N
50070 gosub 50550
50080 gosub 50520
50080 C
50080 then 50080
50090 N
50090 PO
50090 C
50090 PO
50090 N
50090 N
50090 goto 50070
50100 C
50100 N
50100 then 50080
50110 C
50110 N
50110 then 50080
50120 C
50120 N
50120 then 50080
50130 C
50130 N
50130 then 50080
50140 C
50140 N
50140 then 50080
50150 C
50150 C
50150 C
50150 C
50150 C
50150 thengosub 50540
50150 goto 50080
50160 C
50160 N
50160 D$
50160 D$
50160 gosub 50410
50160 goto 50090
50170 C
50170 N
50170 D$
50170 D$
50170 gosub 50410
50170 goto 50090
50180 C
50180 D$
50180 gosub 50410
50180 goto 50090
50190 C
50190 N

```

program is stored.

Line 50070 is reused again later, and if 'C' (the character being examined) is a zero, it indicates that the last byte of the program line has been reached. In that case, 'N' (the number of the storage location being read) must be decremented by one to update the address pointer (PO) of the next line in the GOSUB 50550.

In Line 50080 the next character is read (GOSUB 50520). If the character ('C') is a space, then the process is repeated until a non-blank character is found.

If in Line 50090 the address pointer of the next line is identified, then PO is updated again.

Lines 50100 through 50140 identify some BASIC statements with two-byte tokens and processing continues with reading the next character in Line 50080. Line 50100 identifies a PEEK; Line 50110, a USR statement; Line 50120, an ABS function; Line 50130, an ATN function; and Line 50140, an SQR function.

Line 50150 determines when processing can skip to the next line without reading to the end of the current line. That can be done when a DATA statement is encountered (token 134) or a REM (token 130), or its equivalent, the apostrophe ('), which is tokenized as 131, and also the LLIST statement (token 155) and LIST (token 148).

**Table 2**  
**Short List of Variables**  
**in Alphabetical Order**

```

AA$
C
D$
I
I$
IM
IX
LA
LA$(SUB)
LI
LL
LR(SUB)
MN$
MX$
N
PL
PO
Q
R
S
T
Z

```

GOSUB 50540 accomplishes the skip to the next line, after which processing continues at 50080 by reading the next character.

Lines 50160 through 50200 are somewhat self-explanatory: They deal with the jump statements (GOTO, GOSUB, THEN and ELSE). Only Line 50190 seems a little out of place — it identifies the two-byte token for RND (255 132). The RND token is not of significance to the *Varlist* logic and the program reads the next character by branching back to 50080. Having disposed of the RND (255 132) token, it can now be deduced in Line 50200 that if the current character is a token 132, it is part of the two-byte token (58 132) representing the statement ELSE. (Does 58 seem familiar? It is the ASCII code for the colon [:], which is used by BASIC to separate statements on the same line. Quite clever, those Microsoft people, using the colon as part of the ELSE logic!)

Now, back to the jump statements. In each case a descriptor (D\$) is being built. This string may contain, for example, the word "then" or "else" and may conceivably have the word "goto" or "gosub" added to it. At this point, a subroutine is performed (GOSUB 50410) that obtains the line reference number, i.e., the line number to which the jump statement has been programmed to jump. Upon return from the subroutine, with the next byte already read, processing branches back to 50090 to determine what to do with this character.

Line 50210 looks at the letter 'M' (ASCII code = 77). This is not an ordinary 'M' though, such as an 'M' that may be part of a variable name. It is the 'M' in CLOADM. The token for CLOAD is 151, and if the byte following it is the letter 'M', then GOSUB 50520 reads it and, immediately afterwards, branches back to 50080 to read the next character. At this point Line 50220 discards any further tokenized BASIC statements, i.e., ASCII codes greater than 127, and branches back to 50080.

Line 50230 finds out if the character read is alphabetic, i.e., if the ASCII code is in the range from 65 to 90, representing the capital letters A to Z. Finally, the program does some real work after all the sifting and discarding up to this point: The subroutine at 50300 assembles the variable name, starting with the character ('C') just read, then adds to it, one byte at a time, until the variable name is completely assembled. After return from the subroutine, *Varlist* branches back again to 50080 to read the next character.

Line 50240 tests to see whether the character read is a quote ("), which is

represented by ASCII code 34. Anything enclosed in quotes is of no interest in this program. Therefore, the subroutine at Line 50270 keeps on reading and discarding characters until it finds the second of a pair of quotes. The main body of this program ends at Line 50250, where processing loops back to read the next character at 50080.

#### What do the Subroutines do?

*Varlist* contains the following subroutines, which are each described here.

- 1) Skip between Quotes — Line 50260
- 2) Build the Variable Name — Line 50300
- 3) Build the Line Number Reference — Line 50400
- 4) Peek at the next ASCII Character — Line 50510
- 5) Skip to the next Line — Line 50530
- 6) Print the List of Variables — Line 50590

#### Skip between Quotes — Line 50260

As described earlier, this subroutine keeps reading and discarding characters until it finds the second of a pair of quotes (ASCII code 34). The subroutine also checks for reasonable length of the string between the pair of quotes. I felt anything in excess of five lines of 32

characters (a total of 160 characters) is probably in error and designed the program to stop in such a case. If this does not apply in your program, simply change Line 50280 accordingly.

#### Build the Variable Name — Line 50300

When powering up CoCo the subscript (LA) used to identify the labeled variable (LA\$) has a value of zero. On each trip through the subroutine, that is, every time a new variable name is stored, the subscript is incremented by one in Line 50310. In Line 50320 the first character of the variable is stored; in 50330 the next character is read.

In Line 50340 the character value of zero indicates the end of the current line has been reached and it is now time to store the current line number (LI) in the array LR(LA). This array is used for later printing to indicate where each variable appears in the target program. The program then branches back to the beginning of the main routine of the program.

Line 50350 tests to see if the byte currently under scrutiny is numeric (ASCII codes 48 to 57) or if it is alphabetic (ASCII codes 65 to 90). If it is alphanumeric, the byte is appended to

the array LA\$(LA) and processing loops back within the subroutine to 50330 to read the next byte. If the character being examined in Line 50360 is a '\$' sign (ASCII code = 36), it is added to the variable name and processing resumes at 50330, getting the next byte.

In Line 50370, if the character is an ASCII code 40, i.e., the opening bracket '(', then the literal "(SUB)" is appended to the variable name to show that the variable is subscripted. In other words, the variable is an array.

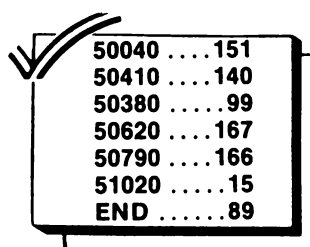
Line 50380 stores the current line number being worked on (and presently being held in "LI") in the Line Reference array, "LR(LA)."

#### Build the Line Number Reference — Line 50400

In Line 50410, which is similar to Line 50310, the subscript LA is incremented by one to store the Line Reference on each pass through the subroutine.

In Line 50420 the line number LI presently being processed is stored in the Line Reference array, "LR(LA)."

Line 50430 obtains the next character, and if it happens to be a blank (ASCII = 32), the program immediately gets the next byte.



50040	....151
50410	....140
50380	....99
50620	....167
50790	....166
51020	....15
END	....89

#### Listing 1: VARLIST

```

10 REM**LINES 10-90 REPRESENT A
TEST PROGRAM FOR DEMONSTRATION.
15 FORO=1TOP:IFQ=RT THENGOSUB123
456789ELSE10
20 S3=T3+U:V(W)=X3
25 NEXT Y: REM Q$
30 IFZ=5 THEN10ELSEGOTO13498
35 A3(56)=1:B345=2:C4444=3
40 IF PEEK(DT)=4 THEN POKE ER,1
45 '!!!
50 IFB=3THENG=9ELSEGOTO10
55 IF H=I THENGOSUB10:GOTO 10 'R
EAD & END
60 PRINT "A=";J;" A3=";K3;"
";L(M);"=ARRAY R":RETURN
65 READ N$:END
70 DATA A,A3,B
90 LIST
50000 *****
* VARLIST *
*(LIST OF ALL VARIABLES)*
*FOR THE COLOR COMPUTER*
* BY HANS SCHULZ (1984) *
*****
50010 CLEAR1500:PCLEAR1:DIM LA$(
500) ,LR(500):CLS
50020 '***INITIALIZE***
50030 N=PEEK(25)*256+PEEK(26)-1
50040 GOSUB50550:GOTO50090
50050 '***READ THE FILE***
50060 GOSUB50520
50070 IFC=0THENN=N-1:GOSUB50550

```

```

50080 GOSUB50520:IFC=32THEN50080
50090 IFN=PO ANDC=0THENPO=PEEK(N
+1)+PEEK(N)*256:GOTO50070
50100 IF(C=134ANDPEEK(N-2)=255)T
HEN50080
50110 IF(C=131ANDPEEK(N-2)=255)T
HEN50080
50120 IF(C=130ANDPEEK(N-2)=255)T
HEN50080
50130 IF(C=148ANDPEEK(N-2)=255)T
HEN50080
50140 IF(C=155ANDPEEK(N-2)=255)T
HEN50080
50150 IFC=134ORC=130ORC=131ORC=1
55ORC=148THENGOSUB50540:GOTO5008
0
50160 IF(C=165ANDPEEK(N-2)=129)T
HEND$=D$+"goto":GOSUB50410:GOTO5
0090
50170 IF(C=166ANDPEEK(N-2)=129)T
HEND$=D$+"gosub":GOSUB50410:GOTO
50090
50180 IFC=167THEND$="then":GOSUB
50410:GOTO50090
50190 IF(C=132ANDPEEK(N-2)=255)T
HEN50080
50200 IFC=132THEND$="else":GOSUB
50410:GOTO50090
50210 IF(C=151ANDPEEK(N)=77)THEN
GOSUB50520:GOTO50080
50220 IFC>127THEN50080
50230 IF(C>64ANDC<91)THENGOSUB50
310:GOTO50080
50240 IFC=34THENGOSUB50270:Q=0:G
OTO50080
50250 GOTO50080
50260 '***SKIP BETWEEN QUOTES***
50270 GOSUB50520:Q=Q+1:IFC<>34TH
EN50270
50280 IFQ>160THENPRINT"CHECK FOR
PAIRED QUOTES":STOP
50290 RETURN
50300 '*** GET VARIABLE NAME ***
50310 LA=LA+1
50320 LA$(LA)=CHR$(C)
50330 GOSUB50520

```

```

50340 IFC=0THENLR(LA)=LI:GOTO500
70
50350 IF(C>47ANDC<58)OR(C>64ANDC
<91)THENLA$(LA)=LA$(LA)+CHR$(C):
GOTO50330
50360 IFC=36THENLA$(LA)=LA$(LA)+
CHR$(C):GOTO50330
50370 IFC=40THENLA$(LA)=LA$(LA)+
"(SUB)"
50380 LR(LA)=LI
50390 RETURN
50400 '***GET LINE # REFERENCE**
50410 LA=LA+1
50420 LR(LA)=LI
50430 GOSUB50520:IFC=32THEN50430
50440 IFD$="then"ANDPEEK(N-1)>12
9THEND$=""
50450 IFC>127THENLR(LA)=0:GOTO500
90
50460 IF(C<48ORC>57)THENLR(LA)=0:
D$="":GOSUB50320:GOTO50090
50470 LL=VAL(CHR$(C))
50480 GOSUB50520:IF(C>47ANDC<58)
THENLL=LL*10+VAL(CHR$(C)):GOTO500
480
50490 LA$(LA)=D$+STR$(LL)
50500 D$="":RETURN
50510 '***GET ASCII FOR NEXT C**
*
50520 C=PEEK(N):N=N+1:RETURN
50530 '***SKIP TO NEXT LINE ***
50540 N=PO-1
50550 PO=PEEK(N+2)+PEEK(N+1)*256
50560 LI=PEEK(N+4)+PEEK(N+3)*256
50570 IFLI>49999THEN50600ELSEN=N
+5:PRINT"... LINE #";LI
50580 RETURN
50590 '***PRINT THE LIST***
50600 PRINT:PRINT" PROCESSING
COMPLETE ...":PRINT
50610 PL=1
50620 IFLR(PL)>0THENPRINTUSING"#
####;LR(PL);:PRINT" ";
50630 IFLA$(PL)<>"THENPRINTLA$(
PL)
50640 PL=PL+1

```

```

50650 IFPL=FIX(PL/12)*12ANDPL<=L
A THENPRINT@471,"MORE ...":PRINT
:GOTO50670
50660 IFPL<=LA THEN50620ELSE5068
0
50670 IFINKEY$<>" THEN50620ELSE5
0670
50680 PRINT"***END OF LIST***":P
RINT@481,"WHAT WOULD YOU LIKE NO
W? ..."
50690 IFINKEY$<>" THEN50700ELSE5
0690
50700 CLS:PRINTTAB(25)"ENTER"
50710 PRINTTAB(3)"PRINT ON YOUR
PRINTER..P"
50720 PRINTTAB(3)"DISPLAY THE LI
ST .....D"
50730 PRINTTAB(3)"SHORT LIST ...
.....S"
50740 PRINTTAB(3)"END THE PROGRA
M .....E"
50750 PRINTTAB(22)"==> ";
50760 I$=INKEY$:IFI$=" THEN50760
50770 PRINTI$;" <==
50780 IFI$="P" THEN50830
50790 IFI$="D" THEN50610
50800 IFI$="E" THENEND
50810 IFI$="S" THEN50880
50820 GOTO50700
50830 PL=1
50840 IFLR(PL)>0 THENPRINT#-2,USI
NG"####";LR(PL);:PRINT#-2," ";
50850 IFLA$(PL)<>" THENPRINT#-2,
LA$(PL)
50860 PL=PL+1
50870 IFPL<=LA THEN50840ELSE5068
0
50880 '*** SHORT LIST ***
50890 PRINT"ONE MOMENT PLEASE ..
.:PRINT" short list":FORS=1TO
LA:FORT=1TOLA
50900 IFLA$(S)=" THENLA$(S)=" ":
GOTO50930
50910 IFASC(LA$(S))>96 THENLA$(S)
=" ":GOTO50930
50920 IF LA$(S)=LA$(T) ANDS<>T TH
ENLA$(S)=" "
50930 NEXTT:NEXTS
50940 FORR=1TOLA
50950 IFLA$(R)<>" THENPRINTLA$(
R);";":Z=Z+1:LA$(Z)=LA$(R)
50960 NEXTR
50990 '***ALPHASORT THE LIST***
51000 N=Z:S=1
51010 PRINT:PRINT:PRINT" NO
W SORTING ..."
51020 MN$=LA$(S):IM=S:MX$=MN$:IX
=S
51030 FORI=S TO N
51040 IFLA$(I)>MX$ THENMX$=LA$(I
):IX=I
51050 IFLA$(I)<MN$ THENMN$=LA$(I
):IM=I
51060 NEXT
51070 IFIM=N THENIM=IX
51080 AA$=LA$(N):LA$(N)=LA$(IX):
LA$(IX)=AA$:N=N-1
51090 AA$=LA$(S):LA$(S)=LA$(IM):
LA$(IM)=AA$:S=S+1
51100 IFN>S THEN51020
51110 FORI=1TOZ:PRINTLA$(I);"";
:NEXT
51120 END

```

Listing 2: SPEEDUP

```

50001 POKE65497,0'HIGH SPEED
50001 POKE65496,0:POKE65494,0:SO
UND128,20:SOUND128,20'RESETTING
TO NORMAL SPEED

```

continued from Page 37

```

2000 REM GET LEFT STRING
2010 E$=LEFT$(A$,1):RETURN
3000 REM CHECK FOR VALID GAT ENT
RY
3005 V=1
3010 IF E<68 THEN RETURN
3020 IF E>&HBF GOTO 3040
3030 V=0:RETURN
3040 IF E>&HC9 THEN GOTO 3030
3050 V=2:RETURN
5000 REM CHECK FOR MORE DATA IN
B$ OR IN NEXT SECTOR
5010 IF B$<>" THEN A$=B$:B$="":
GOTO 3000
5020 S=S+1:GOTO 250
9000 REM ALL DONE
9010 SOUND 100,20:CLS:PRINT@270,
"DONE"
9020 END
10000 REM GAT DISPLAY
10010 PRINT#D,:PRINT#D,:PRINT#D,
" GRANULE ALLOCATION TABLE LIS
TING"

```

continued from Page 31

```

325 DRAW"C3BM145,10"+G$
330 DRAW"C2BM150,10"+H$
331 SOUND133,2
335 DRAW"C3BM150,10"+H$
340 DRAW"C2BM160,10"+D$
341 SOUND89,2
345 DRAW"C3BM160,10"+D$
350 DRAW"C2BM160,5"+D$
351 SOUND 176,2
355 DRAW"C3BM160,5"+D$
1000 FOR Z=1 TO 1000:NEXT:GOTO10
Listing 4: BATS
0 '<BATS>
1 '(C) 1985, J. KOLAR
10 PMODE3,1:PCLS3:SCREEN1,0
11 DRAW"C1BM0,135R44D10R6U90R10D
30R50D50R40U40R10D40R10U90R40D10
0R10U10R10D10R10U40R20BD54L255"
12 PAINT(5,145),2,1
13 PAINT(5,190),1,1
20 A$="F6E6"
23 D$="E6F6"
30 DRAW"C2BM=X;,-Y;"+A$
32 GOSUB100
35 DRAW"C3BM=X;,-Y;"+A$
40 DRAW"C2BM=X;,-Y;"+D$
42 GOSUB100
45 DRAW"C3BM=X;,-Y;"+D$
50 DRAW"C2BM=X;,-Y;"+A$
52 GOSUB100
55 DRAW"C3BM=X;,-Y;"+A$
60 DRAW"C2BM=X;,-Y;"+D$
62 GOSUB100
65 DRAW"C3BM=X;,-Y;"+D$
70 X=RND(25)*10-10:Y=RND(15)*10
71 GOTO30
100 FOR Z=1TO10:NEXT:RETURN

```

Hint . . .

## Get the Sound Out

You can send sound from your 80C to any amplifier simply by soldering a couple of connections from the RF modulator.

Pin 3 from the RF modulator and any PC Board ground will give you audio output that you can send to any outside amplifier.

Incidentally, Pin 3 is the third pin back from the rear of the 80C on the RF modulator.

You should remember that opening the computer case will void your warranty.

Hint . . .

## What's Your ROM Version?

With all the talk about new ROMs, you may be wondering exactly which ROM you have. If you have an older CoCo with Extended BASIC, just read the version number of your Extended BASIC at the top of the screen on power up. Then, to see which Color BASIC ROM you have, type EXEC 41175 and press ENTER.

If you have the new ROMs, Extended BASIC will be Version 1.1 and Color BASIC will be Version 1.2.

On the CoCo 2, Color BASIC will always be Version 1.2 or 1.3 (which are functionally identical).

*The third installment of the "beginner's hardware course"*

# An Introduction to Timing

By Tony DiStefano

Continuing our journey into the CoCo, this month I will look into the heart of this and any computer — timing. All the hardware of the computer is controlled by timing. The most important part of the timing is to keep the CPU in step. What is a CPU, anyway? Well, the letters CPU stand for Central Processing Unit. The CPU inside the CoCo is the MC6809. The CPU, in a way, does all the work. It can move data from one part of memory to another, compare two values and act according to the result, add and subtract values and so forth. In fact, without the CPU, the rest of the hardware that makes up a computer would be worthless. The CPU is a very complex chip. It has data lines, address lines, interrupt lines, status lines and more. The timing that goes with the CPU is also important. OK, let's get into it. It is a prerequisite to understanding how a CPU works.

Up till now, when I talked about zeros and ones and the change from one to the other, it was considered to be instantaneous. There was no mention of how long it took to change from one

state to another. In fact, we are dealing with real life, not just theory. Situations in theory rarely work in real life the way you want or expect them to. Welcome to the real world of delays. Ever caught an on-time airline flight? Ha!

The first fact of the real world is propagational delay. Take, for instance, a simple inverter. Figure 1a shows an inverter. When there is a '1' at the input there is a '0' at the output. A '0' input will give a '1' output. But when the input changes from one state to another, there is a short delay before the output changes. This delay is called the propagational delay, which means the amount of time it takes an electrical signal to go through a logic element or wire.

Figure 1b shows a graph of the input and the output of an inverter. The X-axis (from left to right) shows the passing of time. This can be in seconds, hundredths of seconds, thousandths of seconds and even millionths of seconds. When no time base is given, then time factor is not relevant. Typical delay times for the TTL family (more on chip

families in later articles) is from five to 30 ns (ns = nanoseconds). The Y-axis usually shows the binary level of '0' and '1'. When two or more signals are shown that are related to each other, they are shown on top of each other with the left-to-right passing of time common to each.

Getting back to Figure 1b, we see the passing of time and the relation of the input to the output. There is no delay shown in this diagram. To show the delays of each signal for a given complex gate would confuse the diagram. Instead, an overall delay is given for the gate. But, in order to get used to the idea of delays, Figure 1c shows the time delays of a typical inverter. Along with the delay of the signal there is also the *rise* and *fall* time. The rise time of a signal is described as the time it takes for a given signal to reach 90 percent of maximum voltage from the 10 percent voltage level. The fall time of a signal is described as the time it takes for a given signal to drop to 10 percent voltage from the 90 percent voltage level. In the case of the CoCo, the voltage considered a logical level of '1'

Figure 1a

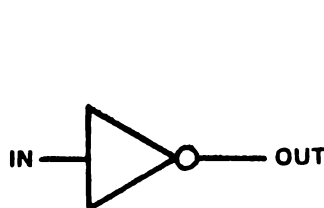


Figure 1b

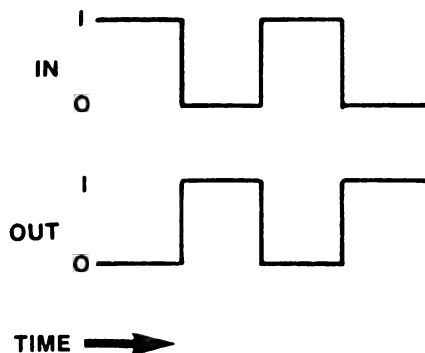


Figure 1c

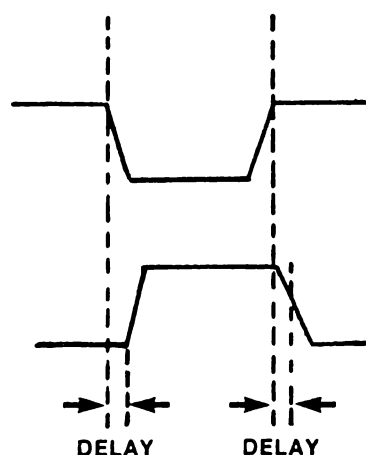


Figure 2a

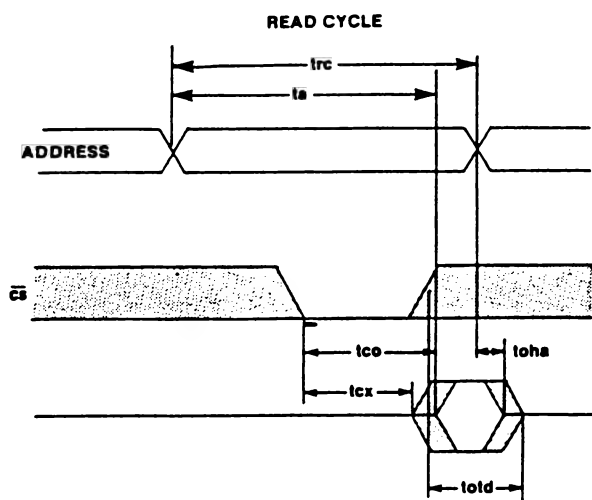
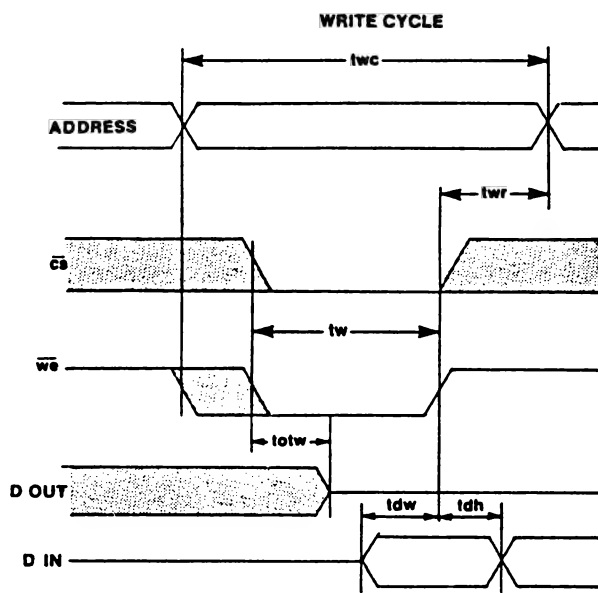


Figure 2b



(or HI) is five volts. The logical level '0' (or LO) is, of course, zero volts. The actual working voltages may be slightly different.

Delay, rise and fall times are important mainly to the designer of the system. When an engineer designs a computer he must know these timings and make sure that all operations are within the given limits. For example, two signals go to one gate, but one goes through several gates first. Each time the signal travels from one gate to another there is more delay. If the signal is delayed enough, an improper signal output results.

It sounds like I'm making a big deal of delays. While it is important, it is not a major concern to computer hackers (or should I use the term hobbyist?) and even less to end users. More important to us is another kind of delay. It is known as "access time," which means the mean time between the request for memory and the actual valid data.

Let us look at a typical memory chip. There are thousands of gates and transistors inside this chip. All of these gates inside the chip cause a significant delay between the time when the address to the chip is valid and the time when the data output appears on the data bus. This is known as access time. When talking about memory, an important parameter is access time. These access times can range from super-fast static memory at about 10 ns to very slow dynamic memory at 450 ns and slower. It is this limitation that controls and limits the speed of CPUs. Figure 2a shows the read cycle timing diagram of a memory chip. Figure 2b shows the

write cycle for the same chip. What follows is a description of what each line on the diagram means.

**Address** — These are the address lines that select what byte is to be accessed. It is shown with two lines, one high and one low. It is shown this way because there are usually several lines and since the timing is the same no matter what byte you access, it is not relevant which address line is high or which line is low. The two lines (one on top and one on the bottom) represent any given address within the chip. Where the lines criss-cross means a change of address. That is when the CPU is finished with that byte and requests another by putting another address on the bus. Access times are always measured with respect to the address change from the CPU. Actually, it starts when the address is stable, better known as a "valid address."

**Chip Select (CS)** — Remember the \*CS line on memory chips in past articles? It is used to select or activate the chip. From the diagram of the read cycle, we can now see the relation between when the address is valid, the \*CS line and when the data is valid.

**Data out** — This, of course, is the data that the CPU requested. Notice the data valid area. That is the time when the data that appears on the bus is the data that is held in that memory location. Notice the top and bottom dual line display. It has the same description as address lines, some are ones and some are zeros. The line in front of the data valid section is halfway between zero and one. That means the data lines are

tri-state and no valid data is input or output. The shaded area on both sides of the data valid window is the transition time between tri-state and data valid. In this area, data lines are changing to their proper values. A read in this area will not yield valid data.

**Read/Write** — The \*R/W line is used to select a read cycle or a write cycle. Straightforward, no problems there. In the CoCo this line is logical '1' to read and '0' to write.

The following is a description of all the relevant parameters used in Figures 2a and 2b.

$t_{rc}$  — Read Cycle Time: the time it takes for a complete read cycle given in ns.

$t_a$  — Access Time: the delay between a valid address and data valid.

$t_{co}$  — Chip Select to Output Valid: the delay between when the \*CS is active and the data is valid. This is only true with a valid and stable address.

$t_{cx}$  — Chip Select to Output Active: same as  $t_{co}$  but not to data valid; to when the data lines start changing from tri-state to output. Usually of minor importance.

$t_{otd}$  — Output Tri-state from Deselection: the time that the data stays valid after the \*CE goes inactive or deselected.

$t_{oha}$  — Output Hold from Address Change: the time that the data stays valid after an address change is detected.

t(wc) — Write Cycle Time: same as the t(rc) except for a write cycle.

t(w) — Write Time: the minimum time the write line has to remain low.

t(wr) — Write Release Time: time between the \*WE line deselects and a change of address.

t(otw) — Output Tri-state from Write: the time it takes the data lines to go to tri-state from a write request.

t(dw) — Data to Write Time Overlap: the time data must be stable before the \*WE line deselects.

t(dh) — Data Hold from Write Time: the time data must be stable after the \*WE line deselects.

Figures 2a and 2b show the read and write cycle paramaters for a typical memory chip. Though these are not the memory chips inside the CoCo, the timing and paramaters are quite similar.

Now with no further *delays*, it is time to look into the CPU . . . well, sort of! There is one more thing we must look into; it is CPU related, though. We are getting closer. It is the master clock, which is a master reference wave form used to synchronize all of the logic in a system.

The master clock is usually the highest frequency in the computer. All other timings are derived (divided) from this clock. The CPU clock is the speed or frequency at which all instructions and data are retrieved and stored to memory. Depending on the system design, the CPU clock can be equal to the master clock, or any division thereof. In the case of the CoCo, the master clock frequency is 14.31818 MHz (mega-hertz or million hertz) and the CPU clock frequency is 1/16 that of the master clock at 0.8948 MHz. Well, there are two clock speeds in the CoCo. Under special conditions, the CPU can work at 1.8 MHz.

Now you might say, "Wow, my CoCo has a clock rate of only .894 MHz!" Compared to that of the 4 MHz of other computers, that may or may not be slower. You see, it gets more complicated. The CPU clock does not always mean the net speed of the computer. There are some other factors involved, such as synchronous I/O, as opposed to asynchronous I/O.

Let's look at synchronous I/O first. As the word implies, synchronous I/O means that any memory, read or write, is synchronized. Synchronized to what? The CPU clock, of course. On any given clock cycle, the CPU can do one I/O. You know exactly when the CPU will need the bus. It corresponds to the clock cycle. In an asynchronous situation, the CPU requires more than one clock cycle to do a read or write. Asynchronous I/O requires either three or four cycles depending on what kind of I/O it is doing. On this type of CPU, signals are required to tell memory or other devices that an I/O has started.

Just about now, a little bit of math is required. Given that the clock frequency of the CoCo is 894886 hertz or 0.894 MHz, one clock cycle is 1117 nanoseconds. The way I did this is to transfer from frequency to time period. The equation used is:

$$T = 1/F$$

where 'T' is in seconds and 'F' (frequency) is in hertz. So the frequency of 0.894 MHz is a time period of .000001117 seconds, or 1117 nanoseconds, or 1.117 microseconds. Now, when we talk about speed, we can say that the CoCo can do about one I/O per microsecond — a much more accurate way to measure the effective speed of a CPU.

I hope these articles about the hardware of the CoCo are informative to you. Also, I hope I am not going too fast; it is hard for me to judge what audience I am writing for. If you have some comments to make, a direction to take or something you don't understand, write to me through RAINBOW and I'll try to answer the interesting and common ones here in this column. Next time, we'll look deeper into the heart of the CoCo. ☺

Figure 3

#### READ CYCLE

SYMBOL	PARAMETER	MIN	MAX	UNIT
tpc	READ CYCLE TIME	250		NS
ta	ACCESS TIME		250	NS
tco	CHIP SELECT TO OUTPUT		85	NS
tcx	CHIP SELECT TO OUTPUT	10		NS
totd.	OUTPUT TRI-STATE FROM DESELECTION	15		NS
toha	OUTPUT HOLD FROM ADDRESS CHANGE		20	NS

#### WRITE CYCLE

SYMBOL	PARAMETER	MIN	MAX	UNIT
twc	WRITE CYCLE TIME	250		NS
tw	WRITE TIME	135		NS
twr	WRITE RELEASE TIME	0		NS
totw	OUTPUT 3-STATE FROM WRITE		60	NS
tdw	DATA TO WRITE TIME OVERLAP	135		NS
tdh	DATA HOLD FROM WRITE TIME	0		NS

# COCOCONF '86

DATE:- Sat 30th & Sun 31st August 1986.

# CoCoConnection

To utilise this program, you will require a CoCoConnection - available from ourselves, or from Blaxland Computer Services.

This unit allows you to connect your CoCo to the outside world - ie, to models, Burgular Alarms, Printers, Synthesisers - and so on.

# BITMAN

by Peter Feldtmann

(Sorry 'bout the trains project - time flies when you've got a magazine to run! I hope to be able to give you further details on that project NEXT month! G.)

This month Peter Feldtmann has given us this routine which enables a multitude of operations from simple keyboard inputs to

CoCo.

All the programs occurring in this section of the magazine are supplied with the CoCoConnection when you purchase it.

Our thanks to Blaxland Computer Services for passing on Peter's work. You can see the CoCoConnection operating at Blaxland.

## The Listing:

```
1 'BITMAN for the CoCoConnection
  This program enables sequence
  s of bit combinations to be set
  up including delays, by simple k
  eyboard input.
  Prog by Peter Feldtmann
  C/o Blaxland Computer Services.
2 GOTO10
3 SAVE"BITMAN:2":STOP
10 REM INITIALIZATION ROUTINE
20 REM INITIALIZE PORT 2B AS OUT
  PUTS
30 POKE 65415,4:POKE 65414,255:P
  OKE 65415,0:POKE 65414,255:POKE
  65415,4
40 REM INITIALIZE PORT 2A AS INP
  UTS
50 POKE 65413,0:POKE 65412,0:POK
  E 65413,4
60 CLS:PRINT "PORT 2A INITIALIZE
  D AS INPUTS"
70 PRINT
80 PRINT "PORT 2B INITIALIZED AS
  OUTPUTS"
90 GOTO 5000
100 CLS:Q = 65414
110 INPUT"PLEASE ENTER NUMBER OF
  SETTINGS";COUNT
120 DIM NPT(COUNT),NUM$(COUNT),D
  (COUNT)
125 PRINT " "
126 PRINT " "
130 FORJ=1 TO COUNT
135 PRINT " "
136 PRINT " "
140 GOSUB 1000
150 GOSUB 2000
160 NEXT J
170 FOR J = 1 TO COUNT
180 PRINT USING"####";NTP(J)
190 NEXT J
200 PRINT :PRINT"PRESS ANY KEY T
  O CONTINUE"
205 A$=INKEY$:IF A$="" THEN 205
210 FOR I = 1 TO COUNT
220 POKE Q,NTP(I)
230 FOR J = 1 TO D(I):NEXT J
240 NEXT I
250 PRINT :PRINT"PRESS ANY KEY T
  O CONTINUE"
255 A$=INKEY$:IF A$="" THEN 255
260 GOTO 3000
1000 PRINT:INPUT"ENTER OUTPUT NU
  MBERS TO SET";NUM$(J)
1010 FOR I =1 TO LEN(NUM$(J))
1020 N$=MID$(NUM$(J),I,1)
1030 A=INSTR("87654321",N$)-1
1040 TMP =2^A:NTP(J) = NTP(J) +
  TMP
1050 NEXT I
1060 RETURN
2000 INPUT"PLEASE ENTER DELAY";D
  (J)
2010 RETURN
3000 PRINT "WANT TO SAVE THIS SE
  QUENCE (Y/N) ";
3010 A$=INKEY$:IF A$="" THEN 301
  0
3020 IF A$="Y" THEN 4000
3030 IF A$<>"N" THEN PLAY "GFEDC
  ":GOTO 3010
3040 RUN
4000 INPUT "ENTER FILENAME ";NAM
  $
4010 OPEN "O",-1,NAM$
4015 PRINT #-1,COUNT
4020 FOR I=1 TO COUNT
4030 PRINT #-1,NTP(I),D(I)
4040 NEXT I
4050 CLOSE
4060 RUN
5000 PRINT "LOAD SEQUENCE FROM T
  APE (Y/N) ";
5010 A$=INKEY$:IF A$="" THEN 501
  0
5020 IF A$="Y" THEN 6000
5030 IF A$<>"N" THEN PLAY"GFEDC"
  :GOTO 5000
5040 GOTO 100
6000 INPUT "ENTER FILENAME TO LO
  AD ";NAM$
6010 OPEN "I",-1,NAM$
6020 INPUT #-1,COUNT
6025 DIM NTP(COUNT),D(COUNT)
6030 FOR I=1 TO COUNT
6040 INPUT #-1,NTP(I),D(I)
6050 NEXT
6060 CLOSE
6070 GOTO 170
10000 POKE150,41:PRINT#-2,CHR$(2
  7);CHR$(29);CHR$(27);CHR$(82);CH
  R$(32)
```



## BARDEN'S BUFFER

# Listening to Your CoCo with Assembly Language

By William Barden, Jr.

One of the nice things about assembly language is that it gives you access to parts of the computer that just can't be handled through BASIC. Take sound effects and music, for example. Sure, you can use SOUND in Extended BASIC to sound a tone for a certain length of time. You can also use the PLAY command in Extended BASIC to play musical notes. However, with BASIC you are limited to these short, simple tones. Assembly language, on the other hand, allows you to create a variety of complex sounds. Want a car crash, a phaser blast, or the sound of an Apple IIe being dropped from the top floor of One Tandy Center? Assembly language is the only way to go. Would you believe that these sounds are already programmed into your CoCo? I'll show you how to unleash the CoCo's sounds in this column. Actually, there'll be two major themes this month. First, we discuss assembly language sounds. Secondly, I'll show you how to plan and use a *Sound* program, for those of you who are still a little shaky about using *EDTASM+* or Disk *EDTASM*. As I mentioned last month, you OS-9 users can still benefit from the column, but the examples will be in *EDTASM* format.

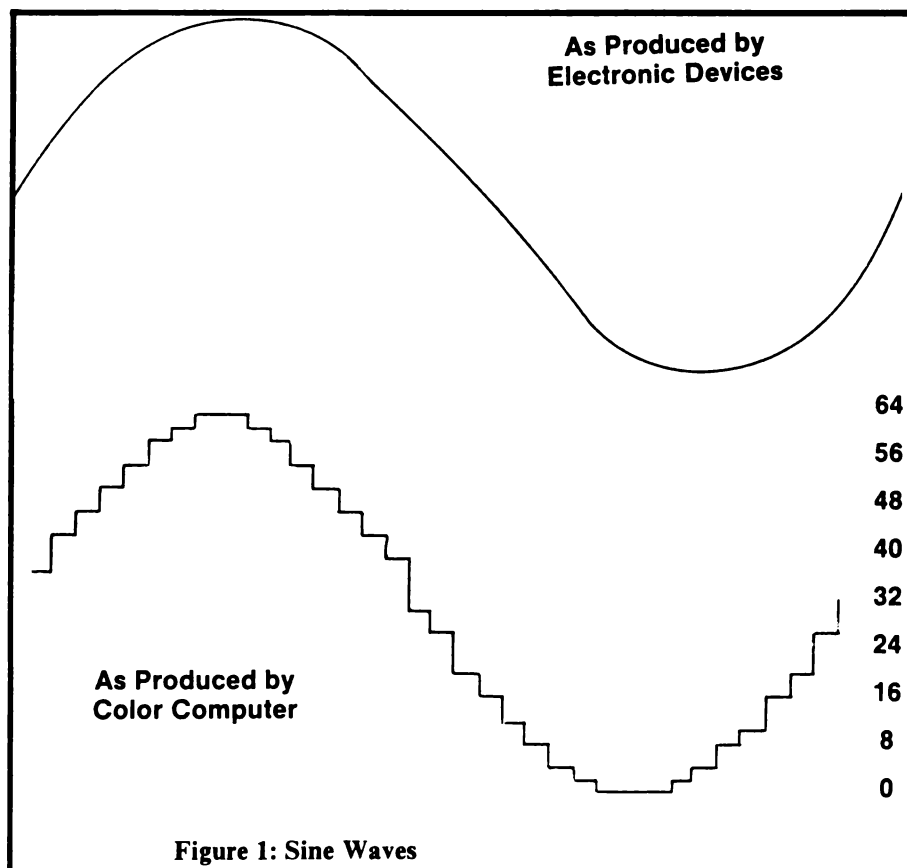
### Color Computer Sounds

Sounds on the Color Computer are generated quite differently from sounds on the Tandy 1000 or other systems. Many other systems contain a sound synthesizer chip. This is an integrated circuit similar in appearance to many of the chips you'll see inside the CoCo. Internally, though, a sound synthesizer chip contains logic to generate square waves or sine waves and to create

different envelopes that determine the wave shape.

The Color Computer does not use a sound synthesizer chip. Instead, it creates sounds by electronic logic that makes up a digital-to-analog converter. I'll call this logic a DAC for short. The CoCo DAC is a "six-bit" DAC, meaning that it will convert a digital value of zero through 63 into 64 different voltage levels. The CoCo DAC uses the upper six bits of a byte in the conversion. Here are the results we'll get with a range of values:

Digital Value	Voltage Output
00000000	.23 volts
00000100	.30
00001000	.37
00001100	.44
00010000	.52
00010100	.59
00011000	.66
.	.
.	.
.	.
11111000	4.69
11111100	4.76



Note that the the lower two bits of the digital value are always zero — only the upper six bits change. You can also see that the step size of the voltage output is constant. There is always about 0.07 volts between one digital value and the next.

All well and good, but how does the DAC create sounds? Let's take an example. The purest sound is a sine wave, shown in Figure 1. The second part of the figure shows a comparable sine wave generated by the DAC. When fed into an audio amplifier, the result will be a relatively pure musical tone, similar to that produced by an electronic doorbell, or a Dolby test tone.

If you look closely at the DAC sine wave, you can see that it's made up of a series of discrete voltage levels, giving it a "staircase step" appearance. The closer the interval is between steps, the smoother the sine wave becomes, as shown in Figure 2.

This sine wave was generated by the CoCo DAC from a table in ROM. Believe it or not, this is the way the CoCo generates the 1200 and 2400 hertz (cycles per second) tones used for cassette tape output! (I'll tell you where to find the table later.)

The distance from crest to crest, or from trough to trough of the sine wave is called the *period* of the sound. The reciprocal of the period is the *frequency* of the sound. A 600 hertz tone, then, has a period of 1/600 seconds or about 1.66 milliseconds (1.66 thousandths of a second).

### More Complex Sounds

Imagine tuning in MTV and listening to a new heavy metal band playing sine wave synthesizers. It would drive the viewers to Mozart! Most natural and instrumentation sounds are made up of a combination of frequencies, as shown in Figure 3. Random sounds, such as surf or crowd noise, are made up of an even combination of all frequencies, giving a hissing effect. These are the sounds that BASIC cannot create on the CoCo with simply the SOUND and PLAY commands.

A music synthesizer not only provides the capability to generate the complex sound of strings or a flute, but it also allows the user to define an envelope for the sound. The envelope describes how the sound varies in loudness and is sometimes called an ADSR, for attack, decay, sustain, release, as shown in Figure 4. A musical instrument such as a piano has a sustained sound, while an instrument such as a snare drum has a much shorter duration

sound. Both envelopes are different, as shown in the figure. Synthesizers also provide the capability to create envelopes not produced by musical instruments, such as a sound that starts off at the minimum loudness and builds to a maximum, producing a sound like a musical tone played backwards on a tape recorder.

Many complex sounds can be generated by the CoCo, at the expense of building a table of values that define the wave shape of the sound. Another

alternative is to use the patterns found in the CoCo's ROM, selecting those that produce the sounds you're looking for. A short section of BASIC ROM code from \$A9EB through \$A9FF on my systems, for example, produces the wave shape shown in Figure 5 when the upper six bits are considered.

Any small section of code can be repeated over and over, and the interval between outputs to the DAC can be varied by timing loops within the assembly language program to produce differ-

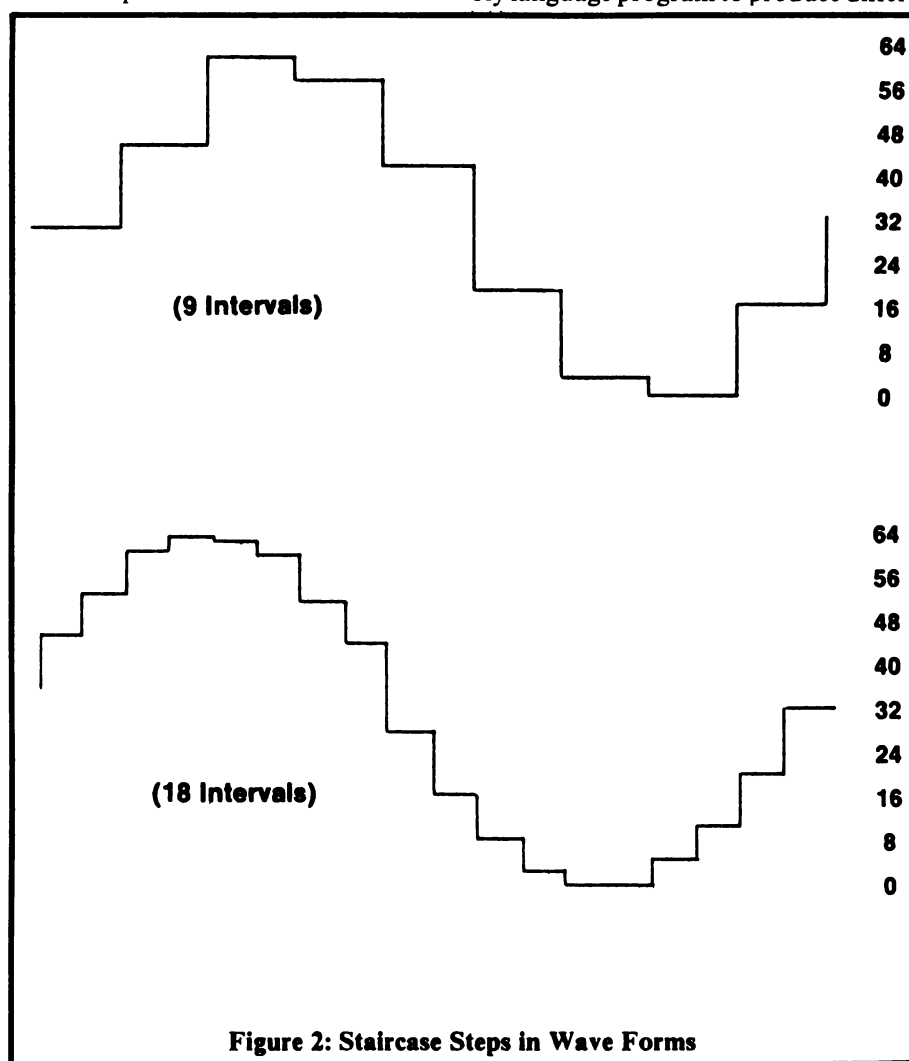


Figure 2: Staircase Steps in Wave Forms

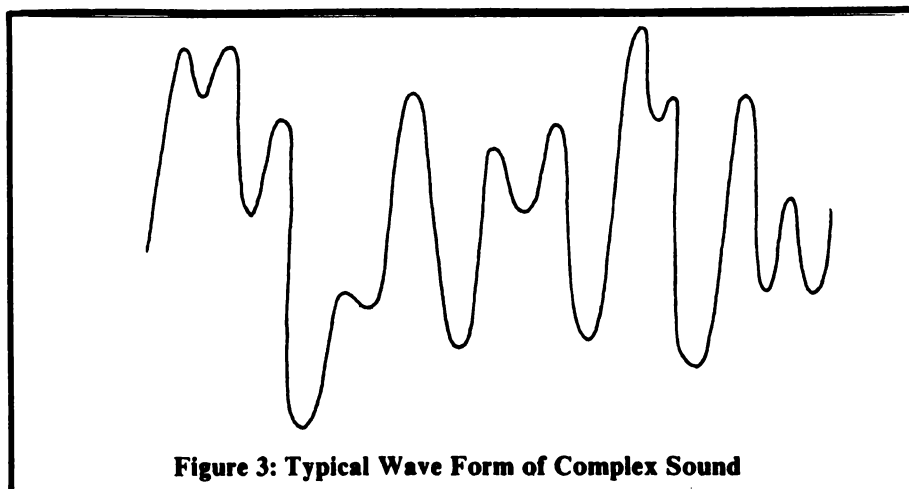


Figure 3: Typical Wave Form of Complex Sound

ent frequencies. As the shortest timing loop can produce periods that are about 10 microseconds wide, the highest frequencies that can be produced in assembly language are 100,000 hertz radio waves (!), far above the 6,000 hertz sound waves that can be passed through the CoCo electronics. That's the beauty of assembly language here — there's plenty of time left over.

### Talking to the PIA of the CoCo

The output of the DAC goes both to the cassette output and to a device that routes the DAC output to the television sound channel, as shown in Figure 6. The MC14529 routes the DAC output to the TV sound channel by two "select" bits set by the following BASIC commands:

```
180 POKE &HFF01,PEEK(&HFF01)
    AND &HF7 'select bit 0
190 POKE &HFF03,PEEK(&HFF03)
    AND &HF7 'select bit 1
200 POKE &HFF23,PEEK(&HFF23)
    OR 8 'set 6-bit sound
```

The third POKE here sets six-bit sound as opposed to a single-bit "on/off" sound that can also be used.

Once these commands are given, they need not be output again — the DAC is routed to the TV sound channel for the duration of the program.

The six inputs to the DAC are controlled by six signals from another source, as shown in the figure. The source here, as in the case of the two select signals, is a PIA, or peripheral interface adapter. The CoCo uses a number of PIAs to provide programmable signals to control color graphics, sound, cassette operations, and RS-232-C operations, to name a few. In this case, the PIA acts as a simple memory device, holding whatever six bits have been sent to it until another six bits are sent. In BASIC the six PIA to DAC outputs are set by

```
1000 POKE &HFF20, VALUE*4
    'VALUE is 0 - 63
```

In assembly language, the instructions are very similar:

```
LDA #VALUE    value is VVVVVV00
STA $FF20     outputs value to DAC
```

And that's about all there is to producing sounds on the Color Computer — route the DAC output to the television channel and then send out the proper patterns to the PIA/DAC,

spaced at even intervals, repeating the patterns if necessary.

### Putting Together a Sound Assembly Language Program

Now that we know enough about the sound capabilities of the Color Computer, we can put together a short program

to play a variety of sounds, natural and unnatural. What we're looking for is a program that will route the DAC output to the television sound channel and then output a series of digital values to the DAC, spaced at regular intervals. We also need the capability of repeating a series of values for a certain number of

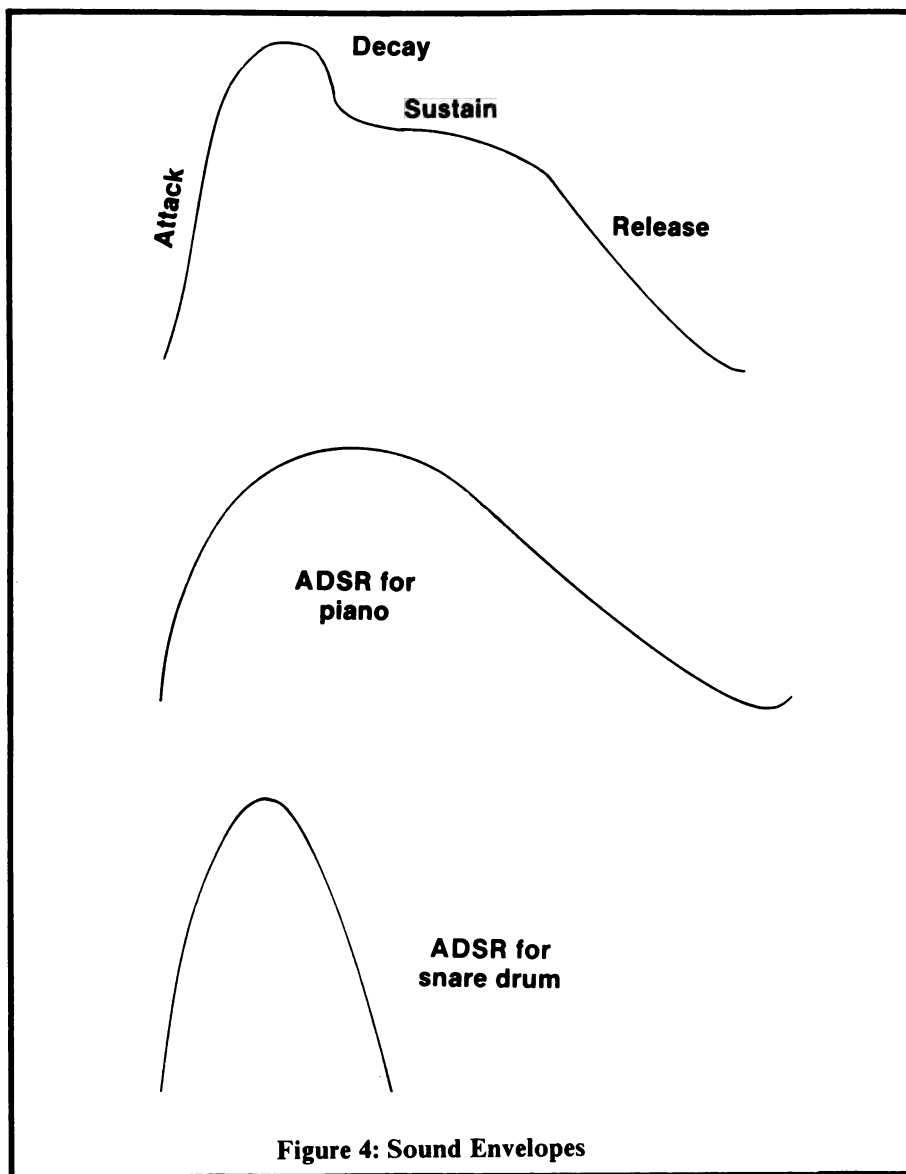


Figure 4: Sound Envelopes

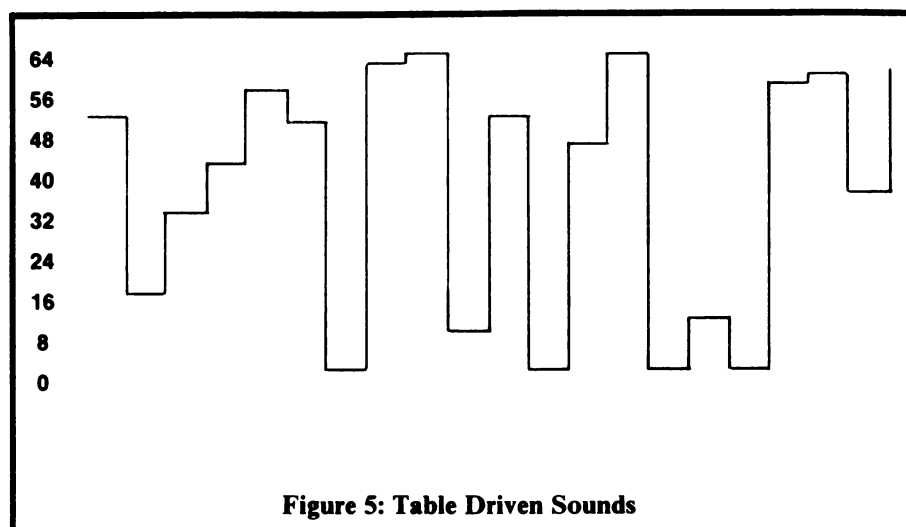


Figure 5: Table Driven Sounds

times.

The data that creates the sounds will be held in a table in memory, either a table of values that already exist, such as ROM values, or a table that we will create. Since we want to make the program handle a table of varying length, we'll need to specify a table length. An alternative to this is to use a "terminating value" at the end of the table to mark the end. However, we'd like to use ROM data for some of the sounds, and it's awfully difficult to write data to ROM (although one of my CoCos tries this on occasion).

To make the table values easier to generate, we'll also let the program shift the data so that it's aligned in the upper six bits. That way we can put values of zero through 63 in memory bytes without having to worry about what the values would be in their shifted form. Of course another approach is to "pack" the data into consecutive six bits, but this would present a real chore in creating and maintaining the table of data values.

What we have so far, then, is a program that will read a table of values starting from some given memory location and ending at another memory location, with each byte in the table representing an output value of zero through 63. Such a table is shown in Figure 7 — it's the encoded form of a simple bell sound using a square wave frequency.

Another thing that we need to specify to the program is the interval between DAC outputs. Remember, the smaller the increment, the less rough the final wave shape will be. What is a reasonable increment to implement? We know that we'll have to have a timing loop in the program to count off the time between DAC outputs. (Another alternative, however, would be reading in a PIA bit that shows the sync clock for video, appearing every 63.5 microseconds.) Even with assembly language, instructions take a finite time and we can't define a small enough interval by the time the program is coded. We'll let the interval be specified by a count parameter to the assembly language program and see what the minimum interval turns out to be in the final result.

A final parameter that must be specified to the program is the number of times the table must be repeated. A repeat capability is handy to have to generate wave forms that are periodic, such as the sine waves and square waves mentioned above. We may want to repeat thousands of times with short tables of values to get a sound that is seconds long.

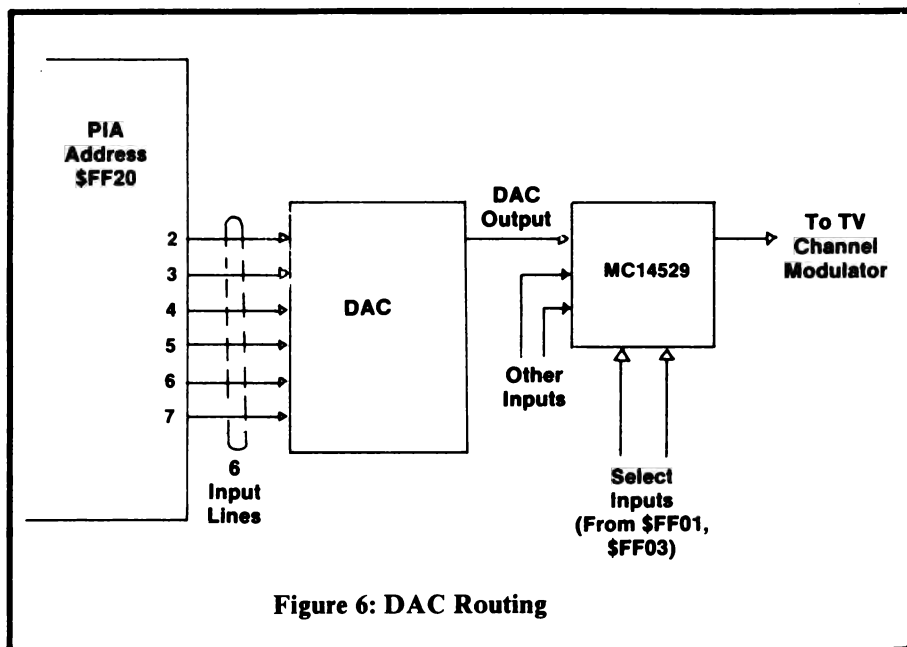


Figure 6: DAC Routing

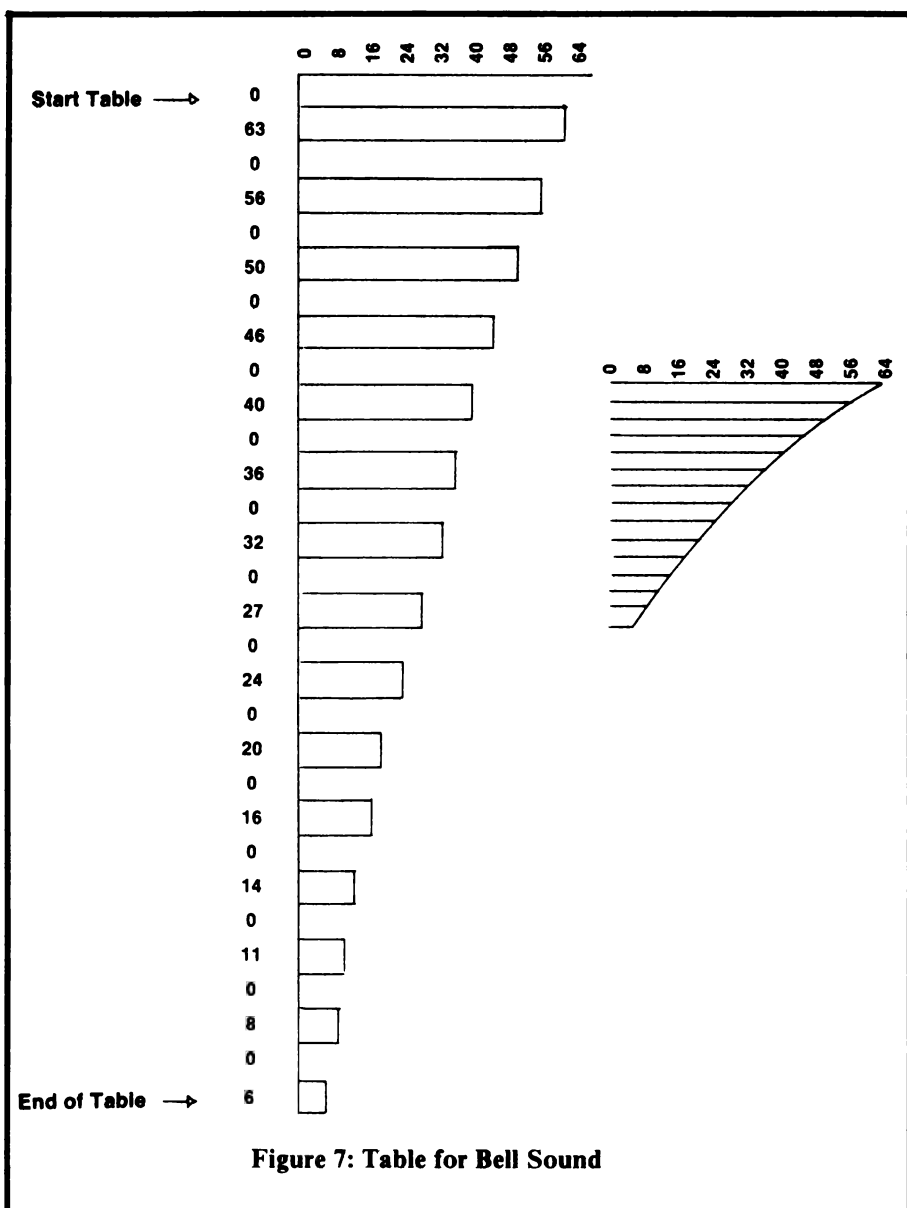


Figure 7: Table for Bell Sound

At this point we have these parameters that must be passed to the assembly language program:

- A 16-bit address that specifies the start of the table.
- A 16-bit address that specifies the end of the table.
- A 16-bit delay count that determines the time delay between outputs to the DAC.
- A 16-bit repeat count that determines the number of times that the table data is to be repeated.

### Program Design Considerations

Before we start coding the program we need to make several more decisions about the basic design:

- Is this to be a program or a subroutine?
- Where in memory will the program be?
- Where in memory will the table be?

### Programs Versus Subroutines

We could make the *Sound* program a full fledged program that could be loaded by LOADM and executed by EXEC (or from cassette by CLOADM and EXEC). However, this doesn't make too much sense, as the program isn't really a full-blown program, but simply a short piece of code that can be used to (presumably) generate short snatches of sounds. For that reason, it makes better sense to design it as an assembly language subroutine that can be called by BASIC (or other languages). That way we can use the convenience of BASIC to do all of the housekeeping and just call the assembly language subroutine when a sound is required.

The commands that Extended BASIC uses to interface to assembly language are DEFUSR and USR. DEFUSR tells BASIC where the assembly language code is located, while USR actually transfers control to the assembly language subroutine. The assembly language subroutine must always end with an RTS instruction, a ReTurn from Subroutine. The RTS acts just as a BASIC statement does, returning control back to the BASIC statement after the USR. The typical call to our yet-uncoded sound subroutine would look like this:

```
110 DEFUSR0 = &H3E08 done only
    once in BASIC
.
.
330 A = USR0(0) 'call assembly
    language sub
340 . . . 'return here
```

The dots between statements 110 and 2100 represent other BASIC statements

that are executed. One thing that must be done before the subroutine is executed, of course, is to set up a table of data in memory that the subroutine will use to generate sounds, or to point to the table if it already exists (such as the ROM sine wave table).

### Where in Memory Will the Subroutine Be?

The DEFUSR statement defines where the assembly language subroutine is in memory. But just where should it be? There are many places it could be, but the overriding rule is to *put it out of the way of BASIC*. BASIC is constantly changing memory by adding variables, manipulating strings, and using a stack area, and any assembly language code must be put into an area that BASIC cannot touch.

One of the best ways to do this is to use a protected area of high memory. The CLEAR statement in BASIC is specifically designed to protect memory so that assembly language subroutines can be put there. Doing a 100 CLEAR 400,&H3DFF for example, protects all memory from locations &H3E00 on up to the top of your RAM memory (512 bytes less than 16K to the top of memory). We'll use this area for the *Sound* program, and you might keep it in mind for your own programs. Of course, if you have a 64K system, you could use 100 CLEAR 400,&H7DFF.

The 400 value, by the way, establishes the size of the BASIC string storage area. Use a larger value if you have many string manipulations in your program or if you have more than 64K.

How does the assembly language

Figure 8:

```
100 CLEAR 400,&H3DFF 'done at beginning of BASIC
110 DEFUSR0 = &H3E08 'done only once in BASIC
120 DATA &HXX, &HXX, ... &HXX 'machine language form
121 DATA &HXX, &HXX, ... &HXX 'of assembly language
140 FOR I = &H3E00 TO &H3E2A 'subroutine
150 READ ML 'move the machine language to
160 POKE I,ML 'the &H3E00 area - done once
170 NEXT I
180 POKE &HFF01,PEEK(&HFF01) AND &HF7 'select bit 0
190 POKE &HFF03,PEEK(&HFF03) AND &HF7 'select bit 1
200 POKE &HFF23,PEEK(&HFF23) OR 8 'set 6-bit sound
.
.
330 A = USR0(0) 'call assembly language sub
340 ... 'return here
```

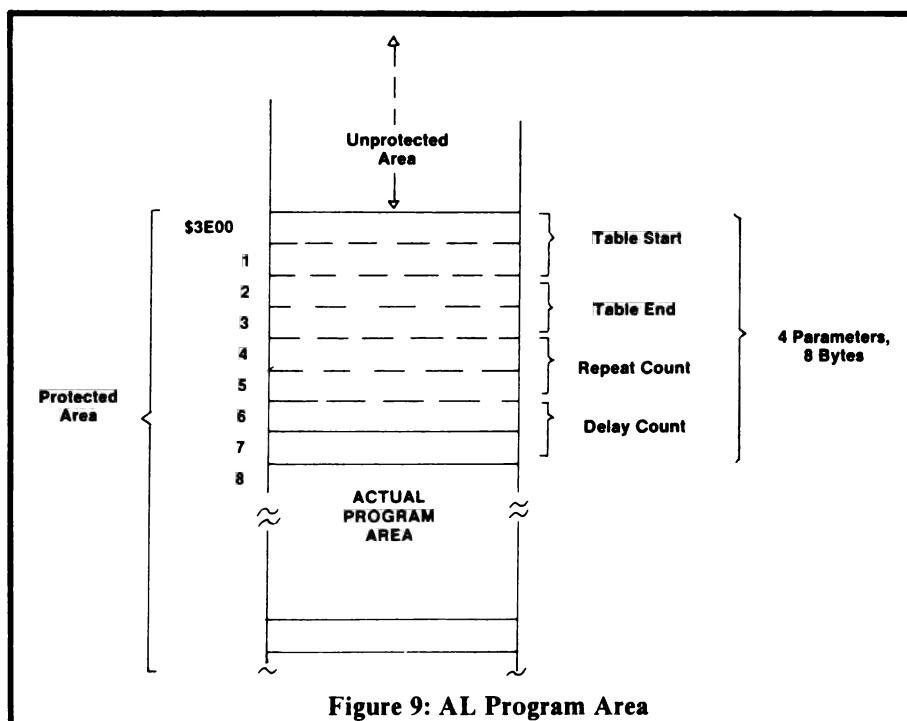


Figure 9: AL Program Area

code actually get into the &H3E00 area? We could load it in by a LOADM (or CLOADM), but it's a real convenience for a short subroutine like this to encode it into BASIC DATA statements and include it in the BASIC program. That way we have everything in one neat little package. The DATA statements use values taken directly from the assembly language listing and look like this:

```
120 DATA &HXX, &HXX, . . . &HXX
121 DATA &HXX, &HXX, . . . &HXX
```

where the XXs stand for machine language values.

To move the machine language values in the DATA statements, a simple FOR/NEXT loop in BASIC is used:

```
140 FOR I = &H3E00 TO &H3E2A
150 READ ML
160 POKE I,ML
170 NEXT I
```

The skeleton form of our BASIC call now looks like this (including signal routine to the TV channel): See Figure 8.

#### Where's the Table?

The next question to resolve before actually coding the program is to determine where the table of data is to be and how to tell the assembly language program where it is. We mentioned before that we'd like to explore some of the areas of ROM to see what kinds of sounds could be generated from the relatively random data found there. For

that reason, we can't just use a preassigned area of memory as a table. The table address, therefore, will not be fixed.

In addition to the table address, we have to consider how the other parameters will be passed to the assembly language program. The USR statement allows for passing one 16-bit parameter to the assembly language program. This would only take care of one parameter, though, and we have four — table start, table end, delay count, and repeat count.

There are a number of methods that can be used to pass more than one parameter, but we'll choose a simple one for this program — we'll put the parameters in memory right before the program at &H3E00. The assembly language program area will now look like Figure 9, a block of four parameters in eight bytes, followed by the (still) undefined assembly language code. The parameters can easily be poked into the &H3E00 area from BASIC, and we can change all of them at any time by doing a series of POKEs.

#### Coding the Program

Whew! We're finally at the point at which we can start coding the *Sound* program. Everything we've done up to this point has been program design. Generally, the more time spent in design, the fewer changes we'll have in coding and debugging the program.

Before coding this program, I gave some thought about what registers could be used to hold the parameters. In such a short program, it is possible to dedicate registers for specific functions. In longer programs, of course, the

registers can't be dedicated to any specific thing, but handle all kinds of tasks.

In *Sound*, the registers are set up this way:

- Register A is used as the main "working" register, holding the values to be sent to the DAC and other results.
- Register X holds the 16-bit delay count.
- Register U holds the table start initially, but is incremented by one to point to successively higher values in the table.
- Register Y holds the 16-bit repeat count.

Having as many things as possible in registers speeds up *Sound* considerably.

The complete listing of *Sound* is shown in Listing 1. Here's a short discussion of how it works. First, the repeat count is loaded into 'Y' from the parameter block (it's four bytes from the address in 'U'). This repeat count will be decremented down to zero through the program. When it reaches zero, the program has repeated the table values the number of times specified in the repeat count. Notice that this is a "Program Counter Relative" instruction that does not specify an absolute address. This and other instructions in *Sound* are relocatable, meaning that the machine language code can be moved anywhere in memory without having to reassemble the program.

Next, Register X is loaded with the delay count and Register U is loaded with the table address count from the parameter block.

#### Listing 1: *Sound* Program in Assembly Language

3E00	00100	ORG	\$3E00	
3E00	00110	BLK	8	PARAMETER BLOCK
3E08 10AE 8C F8	00120	START	LDY	BLK+4, PCR GET REPEAT COUNT
3E0C AE 8C F7	00130		LDX	BLK+6, PCR GET DELAY COUNT
3E0F EE 8C EE	00140	DAC005	LDU	BLK, PCR GET TABLE POINTER
3E12 A6 C0	00150	DAC010	LDA	,U+ GET VALUE
3E14 48	00160		LSLA	ALIGN TO 6 BITS LEFT
3E15 48	00170		LSLA	BY TWO SHIFTS
3E16 B7 FF20	00180		STA	\$FF20 SEND TO DAC
3E19 1F 10	00190		TFR	X,D GET DELAY COUNT
3E1B 83 0001	00200	DAC020	SUBD	#1 DECREMENT BY ONE
3E1E 26 FB	00210		BNE	DAC020 GO IF NOT DOWN TO 0
3E20 11A3 8C DE	00220		CMPU	BLK+2, PCR TEST FOR END
3E24 23 EC	00230		BLS	DAC010 GO IF NOT END OF TABLE
3E26 31 3F	00240		LEAY	-1,Y DECR REPEAT COUNT BY ONE
3E28 26 E5	00250		BNE	DAC005 GO IF NOT DOWN TO 0
3E2A 39	00260		RTS	RETURN TO BASIC
	00270	END		
00000 TOTAL ERRORS				

## Listing 2: SOUND

```

90 *****
91 *SOUND PROGRAM EXERCISER *
92 *RELOCATES AND CALLS AL *
93 *SOUND PROGRAM. *
94 *****

100 CLEAR 400,&H3DFF
110 DEFUSR0=&H3E08
120 DATA &H00,&H00,&H00,&H00,&H00
121 DATA &H00,&H00,&H00,&H00,&H00
122 DATA &H10,&HAE,&H8C,&HF8
123 DATA &HAE,&H8C,&HF7,&HEE
124 DATA &H8C,&HEE,&HA6,&HC0
125 DATA &H48,&H48,&HB7,&HFF
126 DATA &H20,&H1F,&H10,&H83
127 DATA &H00,&H01,&H26,&HFB
128 DATA &H11,&HA3,&H8C,&HDE
129 DATA &H23,&HEC,&H31,&H3F
130 DATA &H26,&HE5,&H39
140 FOR I=&H3E00 TO &H3E2A
150 READ ML
160 POKE I,ML
170 NEXT I
180 POKE &HFF01,PEEK(&HFF01) AND
  &HF7
190 POKE &HFF03,PEEK(&HFF03) AND
  &HF7
200 POKE &HFF23,PEEK(&HFF23) OR8
210 INPUT "TABLE START";TS
220 INPUT "TABLE END";TE
230 INPUT "REPEAT CNT";RC
240 INPUT "DELAY CNT";DC
250 POKE &H3E00,INT(TS/256)
260 POKE &H3E01,TS-INT(TS/256)*
  256
270 POKE &H3E02,INT(TE/256)
280 POKE &H3E03,TE-INT(TE/256)*
  256
290 POKE &H3E04,INT(RC/256)
300 POKE &H3E05,RC-INT(RC/256)*
  256
310 POKE &H3E06,INT(DC/256)
320 POKE &H3E07,DC-INT(DC/256)*
  256
330 A=USR0(0)
340 GOTO 210

```

The code in DAC020 and the next instruction is the innermost loop in the program. Before this loop, a DAC value has been output by the STA \$FF20 and the delay count has been loaded into Register D from Register X by the TFR X,D instruction. The SUBD decrements this count and the BNE instruction causes a loop back to DAC020 while the count in 'D' is not equal to zero.

The code from DAC010 through five instructions from the end (BNE DAC010) is the next innermost loop. It makes a complete pass through the table of values, sending each value out to the DAC and delaying with the inner loop just discussed. The two LSLA instructions shift the data from the table to align it in the six high bits of 'A'. The LDA ,U+ also increments the pointer value in 'U' by one after the load is done. The CMPU BLK+2,PCR at the end of the loop continually compares the pointer value in 'U' to the end of the table value at two bytes from the parameter block start.

The outermost loop is from DAC005 through the BNE DAC005. It repeats a pass through the table values for the number of times equal to the repeat count. The repeat count in 'Y' is decremented by the LEAY -1,Y each time a complete set of table values has been sent out. When this value has been decremented down to zero, the BNE DAC005 is *not* done, and the program returns to BASIC by the RTS.

## How to Use Sound

You can assemble *Sound* yourself, or simply use the BASIC version shown in Listing 2. The BASIC version will ask you for the Table Start value, Table End value, Repeat Count, and Delay. From here on in you're on your own as to what you specify for these parameters, but here are some suggestions:

To hear how your computer's memory data sounds, specify a start of zero and an end of &HFFFF with a repeat count of 1. You should vary the delay to get higher or lower frequencies as well.

Try the sine wave table at &HA85C through &HA87F to hear the sine wave used in the cassette output. (However, before you do, change Line 125 to read 125 DATA &H12,&H12,&HB7,&HFF to change the LSLA instructions to "no operations." The sine wave table data is already aligned to the left, ready to be sent out to the DAC.) Specifying different delay counts will create higher and lower frequencies and specifying repeat counts of other than '1' will sound the sine wave for longer periods of time.

Try short sections of code repeated many times to create "real-world" noises like car crashes, phaser blasts, and the like.

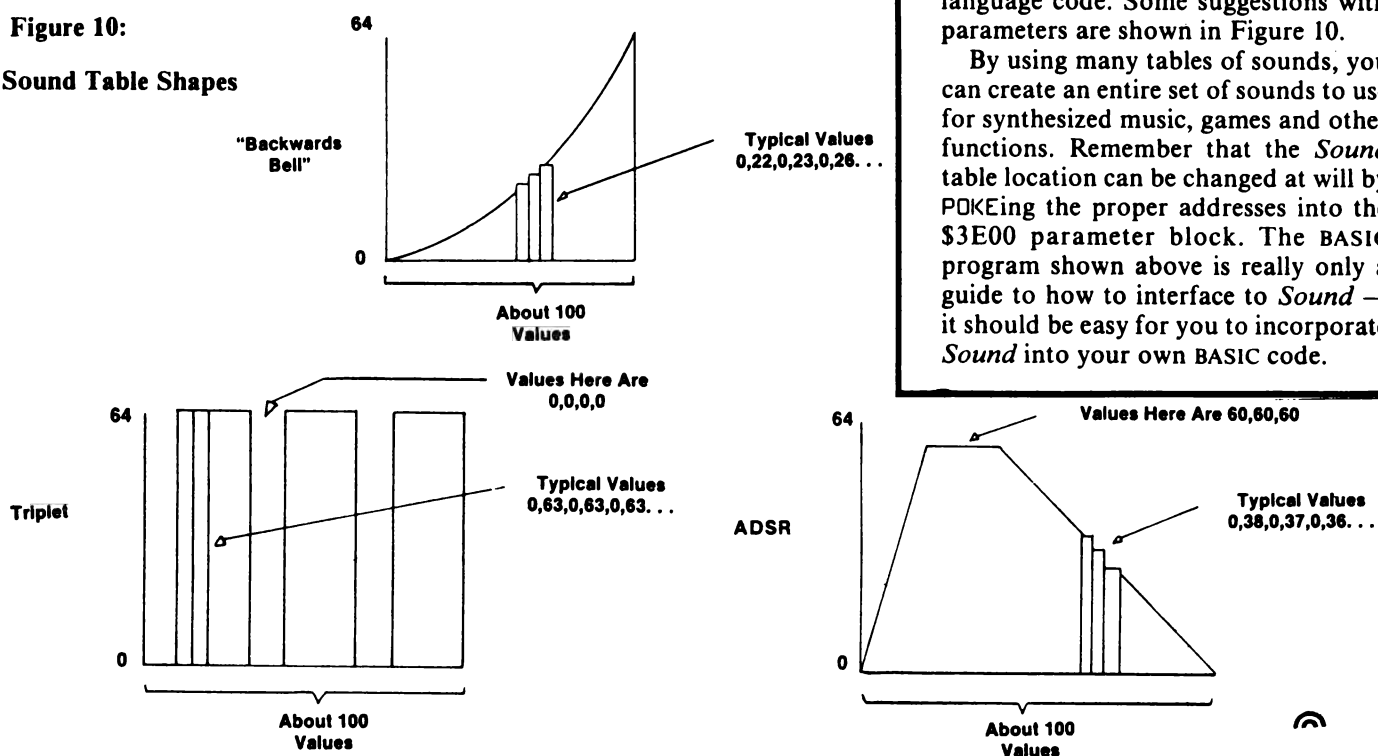
## Constructing Your Own Sound Tables

Just as the sine wave table provides a sine wave sound output, you can construct your own tables of sounds. There's plenty of room to do this in the area beyond the end of the program at &H3E2B through &H3FFF. POKE the values by DATA statements and READ loops just as in moving the machine language code. Some suggestions with parameters are shown in Figure 10.

By using many tables of sounds, you can create an entire set of sounds to use for synthesized music, games and other functions. Remember that the *Sound* table location can be changed at will by POKEing the proper addresses into the \$3E00 parameter block. The BASIC program shown above is really only a guide to how to interface to *Sound* — it should be easy for you to incorporate *Sound* into your own BASIC code.

Figure 10:

## Sound Table Shapes





# CLEARLY SAID, CLEANLY DONE

by John Redmond

Most of the Color Computers around seem to have Extended Color Basic and most of the programs that appear seem to assume this. But why? It's pretty much because of the graphics capabilities - the PMODEs, LINE, CIRCLE, etc. This month, we start an orderly implementation of no less than eleven display modes (ECB allows only five), together with Cartesian capabilities (like LINE, CIRCLE and simple user extensions to SQUARE, TRIANGLE). Then we'll extend things to Turtle Graphics and String Graphics. AND we will do this using absolutely standard Forth and NO extended Basic.

Because the Forth is squeaky-clean standard, it is, with a few patchings at the lowest level, portable to other computers. Furthermore, a from-the-ground-up graphics implementation gives us a chance to design an applications language, which we will call XGAL (eXtended Graphics Applications Language), with a sensible, rememberable, syntax. Look at the parameters for ECB's CIRCLE statement. They are a good example of what to avoid. Microsoft have simply tried to do too much with a single statement. In the language we are about to design, we want to say things in a straight-forward way, like:

```
FINE COLOUR GRAPHICS
MEDIUM SEMI GRAPHICS
RED INK
GREEN PAPER
NEW DISPLAY, etc.
```

The mechanics of implementation of the graphics modes are dealt with in Section IV of the Color Basic manual. All the essential information is there, but it is easy to be put off by the complexity of all the pokes to the VDG, control register and SAM. To make things worse, the mapping of Cartesian coordinates onto the graphics screen is messy for displays other than those in the highest-resolution two-colour mode. It is tempting to be satisfied with an incomplete graphics package, but let's stick to our guns and make sure that we include all the best modes, including three best semi-graphics modes. Two rather dubious modes have been left out, but I don't think that we'll miss 'em.

There are no less than ten important parameters for each of the eleven modes that we will consider. These are tabulated in GRAPHICSARRAY (see Listing). So far so good, but we have to find some way of allocating the correct set for the mode that we want to use and some way of relating this set to the appropriate set of colour bytes and mask bytes in the COLOURSETS and MASKSETS arrays. How?

The clue is in the syntax. The adjectives COARSE ... FINEST are simply numbers which are placed on the stack for use as an index into GRAPHICSARRAY (look at their definitions). RESOLUTION, COLOUR and SEMI check and modify this number ready for GRAPHICS. GRAPHICS is a really smart word (one that looks like a noun and acts like a verb!). It makes sure that the number on the stack is not too large

(why?), then multiplies it by the array width (to get an offset) and adds this result to the array base address. On the top of the stack we now have the address of the start of the correct set of graphics parameters.

The first byte of the set is an offset that COLOURSETS and MASKSETS need to know about. OFFSET therefore pokes this byte into the reserved bytes (initialized as 0 during compilation) at the start of each of these arrays. The rest of the set is then copied into the current attributes array, DESCRIPTION, where it can be accessed by the named pointer words. Finally, a named variable, P/BYTE, is initialized.

Everything is now ready for the two words that give visible results - DISPLAY and PLOT. PLOT will have to wait until next month, but let's look at DISPLAY. A display can be NEW or OLD and/or NORMAL or ALTERNATE. Look at the functions of these adjectives (verbs?) and note how we have permitted an ALTERNATE display ONLY for the true graphics modes and not for the SEMI graphics.

DISPLAY uses values in DESCRIPTION to determine the high-memory pokes carried out by the word REGISTERS (not a noun, but a verb!). This word, in turn, is used by !VDG and VIDEOSTART. I recommend that you set yourself the task of working out how REGISTERS works. It is a good example of Forth's low-level power, but you will need a hint or two:

0< returns a true flag (i.e., 1) if a number is negative. But when is it negative? When the highest bit is 1, of course. Now, if the highest bit IS 1, we have to add 1 to an even address to determine the correct poke location. NOW (wait for it!) the one we add is, in fact, the very logical flag that 0< produced. If the flag had been false, the flag value would have been 0 which, when added to an even address, gives the same even address. This sort of logic arithmetic is discussed in Brodie's 'Thinking Forth'. Finally, 2\* is a very efficient way of doing a left shift to get the next binary bit into the top position for checking, if necessary, with 0<. End of lesson.

The background colour for a normal screen clear is held in DESCRIPTION, in a named location called (PAPER). The foreground colour is held in (INK). Either of these can be altered at any time by PAPER or INK, respectively, prefixed by a colour word. The colours are defined using a special defining word, HUE, which uses COLOURED to access the correct element of COLOURSETS using both the offset passed by HUE and the byte value poked in by GRAPHICS (see above). (Defining words are one of the advanced topics dealt with in Brodie's 'Starting Forth'. They are dazzlingly elegant and powerful and will be discussed in detail in a later article.)

It is unlikely that all this will be grasped at the first reading. Look through the listing methodically, looking at the highest-level (i.e., last) words first. You may, of course, not be even

slightly interested in how it all happens. That's OK. All the work has been done and all you need to do is load these definitions from tape or disk and use them. If you say, from the keyboard or within a program, MEDIUM COLOUR GRAPHICS NEW DISPLAY, you

will get just that.

Do you still think that postfix notation looks funny? Next month, drawing lines and circles in all graphics modes, using sensible commands like:

```

: \ 13 WORD DROP ;
\ XGAL - EXTENDED GRAPHICS
\ APPLICATIONS LANGUAGE,
\ VERSION 1.05,
\ <C> JOHN REDMOND, 1986.
\ PART 1.

\ CODE WRITTEN SPECIFICALLY
\ FOR TANDY COLOR COMPUTER
\ (ALL REVISIONS).
\ EXTENDED BASIC NOT REQUIRED.

HEX
\ ATTRIBUTE ARRAYS, CONTAINING:
\ OFFSET INTO COL/MASK ARRAYS
\ TRUE GRAPHICS FLAG
\ VDGBYTE, CONTROLBYTE
\ PIXEL WIDTH & HEIGHT MARKERS
\ SCREEN SIZE IN BYTES
\ NO OF BYTES PER ROW
\ INITIAL B/GROUND COLOUR

CREATE GRAPHICSARRAY
\ 2-COLOUR MODES
001 , 2090 , 403 , 400 , 1000 ,
001 , 60B0 , 402 , 600 , 1000 ,
001 , A0D0 , 400 , C00 , 1000 ,
001 , C0F0 , 300 , 1800 , 2000 ,
\ 4-COLOUR MODES
801 , 2080 , 403 , 400 , 1000 ,
801 , 40A0 , 303 , 800 , 2000 ,
801 , 80C0 , 302 , C00 , 2000 ,
801 , C0E0 , 300 , 1800 , 2000 ,
\ 8-COLOUR SG MODES
1000 , 4000 , 303 , 800 , 2080 ,
1000 , 8000 , 302 , C00 , 2080 ,
1000 , C000 , 300 , 1800 , 2080 ,

HERE GRAPHICSARRAY - 0B /
CONSTANT ARRAYWIDTH

CREATE COLOURSETS 0 C,
FFFF , FFFF , FFFF , FFFF ,
0055 , AAFF , 0055 , AAFF ,
8F9F , AFBF , CFDF , EFFF ,

CREATE MASKSETS 0 C,
8040 , 2010 , 804 , 201 ,
C0C0 , 3030 , C0C , 303 ,
FAFA , FAFA , F5F5 , F5F5 ,

VARIABLE P/BYTE
VARIABLE <INK>
VARIABLE <ALTERNATE>
6800 CONSTANT VBASE

\ CURRENT GRAPHICS ATTRIBUTES.

\ THE ARRAY IS ACCESSED BY
\ SPECIAL (NAMED) POINTERS.

CREATE DESCRIPTION
ARRAYWIDTH 1- ALLOT
DESCRIPTION 3 + CONSTANT WIDTH
DESCRIPTION 4 + CONSTANT HEIGHT
DESCRIPTION 5 + CONSTANT /SCREEN
DESCRIPTION 7 + CONSTANT B/LINE
DESCRIPTION 8 + CONSTANT <PAPER>

\ COLOUR DEFINITIONS

: COLOURED ( # )
0 MAX 7 MIN
COLOURSETS COUNT + + C@ ;
: HUE CREATE C, DOES>
C@ COLOURED ;
0 HUE GREEN
1 HUE YELLOW
2 HUE BLUE
3 HUE RED
4 HUE BUFF
5 HUE CYAN
6 HUE MAGENTA
7 HUE ORANGE
0 HUE PLAIN
80 HUE BLACK

: INK <INK> ! ;
: PAPER <PAPER> C! ;

\ RESOLUTION TYPES
\ AND ASSOCIATED WORDS

0 CONSTANT COARSE
1 CONSTANT MEDIUM
2 CONSTANT FINE
3 CONSTANT FINEST

: RESOLUTION 0 MAX 3 MIN
0 <ALTERNATE> !
RED INK ;
: COLOUR RESOLUTION 4 + ;
: SEMI 0 <ALTERNATE> !
0 MAX 2 MIN 8 +
YELLOW INK ;

: OFFSETS C@ DUP
COLOURSETS C!
MASKSETS C! ;

: GRAPHICS ( # )
0A MIN
ARRAYWIDTH * GRAPHICSARRAY +
DUP OFFSETS
1+ DESCRIPTION
ARRAYWIDTH 1- CMOVE

WIDTH C@ 3 >
IF OF ELSE 7 THEN P/BYTE ! ;

\ SPECIAL WORDS TO POKE THE
\ ODD OR EVEN ADDRESSES.

: REGISTERS ( BYTE, ADDR, #REGS)
2* NEGATE OVER + SWAP
DO 1 OVER 0< +
0 SWAP C! 2*
-2 +LOOP DROP ;

: !CONTROL ( MASK)
FF22 C! ;

: !VDG ( BYTE)
8 << FFC4 3 REGISTERS ;

: CLEARSCREEN VBASE /SCREEN @
(PAPER) C@ FILL ;

: VIDEOSTART ( VBASE)
FFD2 7 REGISTERS ;

\ COLOUR SET WORDS.

: NORMAL ;
: ALTERNATE
DESCRIPTION C@
<ALTERNATE> ! ;

0 CONSTANT OLD
1 CONSTANT NEW
: DISPLAY ( T/F)
< CONTROLBYTE, VDGBYTE>
IF CLEARSCREEN THEN
VBASE VIDEOSTART
DESCRIPTION 1+ DUP
C@ !VDG
1+ C@ <ALTERNATE> @
IF 8 OR THEN
!CONTROL ;

\ EXAMPLES OF USE:

\ GREEN INK RED PAPER

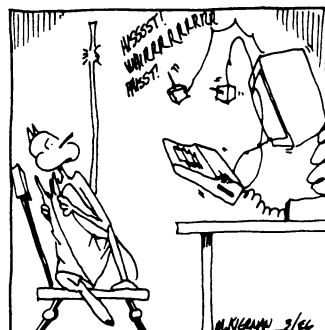
\ MEDIUM SEMI GRAPHICS
\ NEW DISPLAY

\ FINEST COLOUR GRAPHICS
\ ALTERNATE NEW DISPLAY

\ COARSE RESOLUTION GRAPHICS
\ NORMAL OLD DISPLAY

\ 6800 VIDEOSTART

```



## FORTH FORUM

by John Poxon

Before we begin this month's FORTH Forum, I have about 60 c30 audio mastering tapes for sale, at \$1.20 each, plus postage. All are relatively new, fault free and bulk erased. Most have been recorded on once only.

Last month's article introduced Reverse Polish Notation as the modus operandi of FORTH arithmetical operations. The concept of placing the operator (+, -, \* and /) after the numbers to be operated on is fundamental to FORTH and Reverse Polish Notation (R.P.N.).

R.P.N. is not a creation of or for FORTH, but originated in considerations of how arithmetical operations could be more logically and efficiently performed.

Fundamental to our considerations of FORTH arithmetical operations is the storage of numbers during these processes. To understand R.P.N. better we need to understand the stack, which may be regarded as the most important number reservoir.

To begin our analysis of the stack, imagine that you have typed in the following line.

```
1 2 3 4 <ENTER>
```

The numbers have been entered into memory in a last in first out form, which may be regarded as a column of numbers (or a stack), thus:

Top	4
	3
	2
Bottom	1

You can prove the stack contents at anytime by inserting the command .S in your calculations at any appropriate point. I give you the definition of .S without comment, since we haven't yet covered the concepts supporting it. Just type in the following line correctly and press enter. You can then use .S.

```
: .S CR 'S S0 @ 2- DO 1 @ . -2 +LOOP ;
```

The line came from page 50 of Starting FORTH.

Numbers at the top of the stack are most accessible for arithmetic operations and those at the bottom least accessible.

The stack can have, in principle, any depth, but in practice depth is limited. The stack can contain sufficient numbers

for almost any legitimate purpose, so don't worry about overfilling it! This is not true of course, if you generate excess numbers which pile up on the bottom of the stack until a "stack overflow" error occurs. FORTH demands that you provide any necessary protection against stack overflow. Incidentally, to empty a stack full of unwanted data, type some meaningless word, e.g. sss <ENTER> and the stack will be cleared.

If you were next to enter an operator, it would operate on the top two numbers and place the result on the top of the stack. For example, typing \* <ENTER> would result in the product of 4 and 3 being placed on the top of the stack. The stack would then "look" like this:

```
12
 2
 1
```

You may of course have a need to operate on numbers lower down in the stack while leaving the upper numbers intact. There are a certain special FORTH words which permit manipulation of the stack, that is, number positions in the stack may be altered to facilitate calculations. This means, of course, that the required numbers are brought to the top of the stack.

Some useful words are DUP, ROT, SWAP, OVER and DROP. These are not all of the stack manipulation words, but are most of the single length stack operators. We'll worry about double length operators later in this series. The words are easily understood. Let me list their functions below:

DUP	DUPlicates the top number on the stack so that two copies exist at the top of the stack. For example, if we commenced with a blank stack and typed 2 DUP <ENTER> the stack would contain two 2s.
ROT	ROTates the third number down in the stack to the top, e.g.

3		1
2	becomes	3
1		2

SWAP	SWAPs the top two numbers. e.g.
------	---------------------------------

3		2
2	becomes	3
1		1

OVER Copies the second stack number and puts the copy on top of the stack e.g.

```

3
2 becomes 2
1          1

```

DROP DROPS the top number on the stack, e.g.

```

2
3 becomes 2
2          1
1

```

\* + DUP \*/ . . . The stack contents will progressively look as follows.

```

      DUP      *      SWAP      DUP      *      +
14      14      196      12      12      144
12      14      12      196      12      196
36      12      36      36      196      36
      36

```

```

      DUP      ROT      */
340      340      36      3211      3211
36      340      340      on screen
      36      340

```

With these thoughts in mind we can try one or two simple calculations. Remember throughout that this is integer arithmetic (no decimal parts to numbers).

Let's try  $3 \times (10)^2$ . The line

```
3 10 DUP * *
```

will do the job nicely. Stack contents look like this as the calculation progresses. I have written the operation preceding the stack condition above the gap between the stack listings

```

3 10      DUP      *      *
      10      10      100      300      300
      3      10      3      on
      3      screen

```

We would do well to remember that as simple single length numbers (16 bit) the stack values or intermediate results of calculations cannot exceed the range +32767 to -32768. I sense you recoiling in horror at such a profound limitation. Calm down, it's not as bad as it first appears.

FORTH provides ways of getting around these difficulties. Let's begin to talk about them by discussing the word \*/ (pronounced star-slash). This very useful word permits a single length calculation to have a double length (32 bit) intermediary value. It first multiplies and then divides. Like certain other division operators in FORTH the / part of \*/ leaves only the quotient. Care should therefore be taken when deciding the process of a calculation to avoid large errors due to dropped remainders.

Let's try an example to illustrate what we've learned so far. Calculate

$(14^2 + 12^2)^2 \times 36$

The value of  $(14^2 + 12^2)^2$  is more than 16 bits can handle, so the \*/ will come in useful. Entering the numbers in reverse order, the stack looks like this:

```

14
12
36

```

To make the calculation, do DUP \* SWAP DUP

Another example. Find the effective resistance of three resistors ( 10, 20 and 30 ohms) in parallel. The formula for this is

$$R_1 = (R1^{-1} + R2^{-1} + R3^{-1})^{-1}$$

We might expect the value of this expression, using these numbers to be a about half the lowest value of resistor (10 ohms). In fact the correct answer is 5.45 ohms. lets see how FORTH does using integer arithmetic.

Since it doesn't matter which order we process the resistance values we can enter them in any order, thus: 10 20 30 <ENTER>. But how to process them? If we simply divide each value into 1 to achieve a reciprocal we will be confounded by the loss of the quotient referred to earlier.

A solution is to scale each value and ultimately descale the answer. One has to be very careful doing this in problems involving multiplication or exponentiation.

If I divide a resistance value into 1000, the result will be 1000 times greater than otherwise. I'm not trying to insult your intelligence here; Graham would, I know, prefer these tutes written on the K.I.S.S. principle.

From here on there are a couple of ways to tackle the problem. One involves entering the scaling factor of 1000 as required: the other involves setting a constant equal to 1000 and calling up the constant when needed. Since we will tackle constants later in this series, I will restrict myself to the first option.

We have already entered the resistance values. The operations on the stack proceed as follows: 1000 SWAP / 1000 ROT / ROT 1000 SWAP / + + 1000 SWAP / . . . The last period is of course the sentence ending. The stacks go as follows.

```

      /      ROT      1000      SWAP      /      +      +
20      50      30      1000      30      33
1000      100      50      30      1000      50
100      30      100      50      50      100
30      100      100

```

```

      1000      SWAP      /
183      1000      183      5      Prints on
      183      1000      screen

```

continued on Page 57

# THE PROBE

The Probe is our latest piece of equipment for use with either the Colour Computer or the T1000.

Attached to a CoCo, The Probe uses either the right hand joystick port or CoCoMax to provide temperature monitoring.

On a T1000, The Probe connects to the right hand joystick port.

The Probe consists of a cable and a protected transducer, which is inserted into the substance being monitored.

The Probe is not able to cope with highly acidic solutions or temperatures in excess of 100 degrees C.

Temperature readings however, can be taken between -40 and 100 degrees Celcius, with an accuracy of +/- 2 degrees using the T1000 or CoCoMax, +/- 8 degrees read directly through the CoCo joystick port, or +/- 2 degrees C through

the CoCo joystick port with an optional amplifier (price to be announced).

The maximum specified thermal response time of The Probe in still air is 3 minutes (time taken to reach final temp value). However preliminary testing shows that this varies from 50 to 180 seconds.

The Probe is supplied with three programs on tape or disk (please specify) for CoCo or with a disk containing three programs for the T1000.

These programs are meant as thought starters for your own projects, but never the less provide some interesting information.

"BARTEMP" \* is a program which provides you with a simple thermometer on screen. As the temperature of the substance being checked changes, so the reading on

screen changes.

"LOGGER" \* samples temperature over a specified period and provides a print out of the result.

The information below shows the result of a test we made, when we immersed The Probe in a glass of ice water, and after 220 seconds, took it out again.

The third of these programs, "GRAPH", # samples temperature over a set number of periods, for whatever length of time you require, and draws a graph of the results.

\* 16K CoCo's and T1000 128K+

# 16K ECB CoCo's and T1000 128K+

There are a number of uses for this interesting piece of equipment.

It can be used to demonstrate heating and cooling rates to students; it can be used to monitor temperatures in controlled environments, eg hot houses, chicken sheds, fire alarms; and it can be used by experimenters.

Owners of The CoCoConnection will find The Probe of special interest, for it adds to your arsenal of control equipment.

The price is \$49.95 for the versions without an amplifier. The version with amp is likely to be \$59.95.

Graham.

TIME= 0 SECS	TEMP= 34	TIME= 170 SECS	TEMP= 6	TIME= 340 SECS	TEMP= 30
TIME= 10 SECS	TEMP= 34	TIME= 180 SECS	TEMP= 6	TIME= 350 SECS	TEMP= 30
TIME= 20 SECS	TEMP= 36	TIME= 190 SECS	TEMP= 6	TIME= 360 SECS	TEMP= 30
TIME= 30 SECS	TEMP= 34	TIME= 200 SECS	TEMP= 6	TIME= 370 SECS	TEMP= 32
TIME= 40 SECS	TEMP= 18	TIME= 210 SECS	TEMP= 6	TIME= 380 SECS	TEMP= 30
TIME= 50 SECS	TEMP= 12	TIME= 220 SECS	TEMP= 6	TIME= 390 SECS	TEMP= 32
TIME= 60 SECS	TEMP= 10	TIME= 230 SECS	TEMP= 6	TIME= 400 SECS	TEMP= 32
TIME= 70 SECS	TEMP= 10	TIME= 240 SECS	TEMP= 10	TIME= 410 SECS	TEMP= 32
TIME= 80 SECS	TEMP= 8	TIME= 250 SECS	TEMP= 16	TIME= 420 SECS	TEMP= 32
TIME= 90 SECS	TEMP= 8	TIME= 260 SECS	TEMP= 18	TIME= 430 SECS	TEMP= 34
TIME= 100 SECS	TEMP= 6	TIME= 270 SECS	TEMP= 24	TIME= 440 SECS	TEMP= 36
TIME= 110 SECS	TEMP= 6	TIME= 280 SECS	TEMP= 28	TIME= 450 SECS	TEMP= 38
TIME= 120 SECS	TEMP= 6	TIME= 290 SECS	TEMP= 28	TIME= 460 SECS	TEMP= 38
TIME= 130 SECS	TEMP= 6	TIME= 300 SECS	TEMP= 28	TIME= 470 SECS	TEMP= 38
TIME= 140 SECS	TEMP= 6	TIME= 310 SECS	TEMP= 30	TIME= 480 SECS	TEMP= 38
TIME= 150 SECS	TEMP= 6	TIME= 320 SECS	TEMP= 30	TIME= 490 SECS	TEMP= 36
TIME= 160 SECS	TEMP= 6	TIME= 330 SECS	TEMP= 30		

continued from Page 55

The answer, 5 ohms, is about 92 % of the correct answer. This is within the normal production tolerance of commercial resistors. If one required a more accurate answer, using a scale factor of 10 000 would be O.K..

Did you see where I did the descaling? It was of course in the final factor of 1000.

There are many ways of doing this calculation better than this; I hope the FORTH experts out there will not shudder too much. My intention was merely to provide a sample of some stack manipulation. Later in the series I will investigate some of those more efficient

methods; in the meantime you would be best served by reading Starting FORTH. There you will see a wide variety of commands which I cannot, for sake of space and time, discuss here.

One point of re-assurance that I find comforting is that its O.K. to experiment on the computer. A learning experience, successful or not costs no more than a little time and a few cents of power. Your investigations of FORTH are therefore nothing more than a low-cost investment in your understanding of another aspect of programming.

Finally, remember - if you would like to talk about FORTH, feel free to call me on (07) 208 7820.

# Getting Started with BASIC09

By Richard A. White

**Y**ou have been reading about spreadsheets in this column for over six months. I know from letters that many of you have been following the articles and are using spreadsheets now. However, broad as the topic may be, there are other interests to be served.

Over the past few months, I have been learning and programming in BASIC09. Dale Puckett is right on target in praising BASIC09. I hope the tutorials I provide in the coming months will bring you to a similar conclusion.

Under OS-9, there is a wealth of programming languages. assembly language is the same as under Disk BASIC, except for the program/machine interface. Brian Lantz has recently covered Assembly language under OS-9 in THE RAINBOW. A series on PASCAL by Dan Eastham graced the pages of "RainbowTech" some time ago. While the very good DEFT Compiler was highlighted, Radio Shack's Microware PASCAL Compiler is likewise a powerful compiler under OS-9. Another programming language available under OS-9 from Radio Shack is Microware's C Compiler, possibly one of the very best C compilers for a microcomputer.

With these options, why program in BASIC09? BASIC09 is designed for structured programming, but so are PASCAL and C. C is very powerful and terse, although it is not particularly easy to learn. If you have done some assembly language programming and want higher programming productivity while staying close to the machine, C is probably for you. I know one programmer who held out for years before trying C and then wondered why he had been so bull-headed for so long.

Then there are the rest of us, many who have been programming under BASIC and want to do more under OS-9. BASIC09 provides a nice transition language since the key words you have learned under BASIC have the same meanings under BASIC09. Some of the pains in BASIC, like line numbers, are gone (you can still use them, but it's like shooting oneself in the foot). The automatic handling of variables you are used to is gone, but it is replaced by powerful structuring options that provide economy, clarity and speed.

BASIC09 provides a rich selection of control structures, including LOOP . . . ENDLOOP, REPEAT . . . UNTIL, WHILE . . . DO . . . ENDWHILE and EXITIF . . . THEN . . . ENDEXIT, in addition to FOR . . . TO . . . NEXT and IF . . . THEN . . . ENDIF. Both the IF and ENDIF constructions permit the use of ELSE. For those who have no previous experience with some of these structures, take my word that they are indeed nice to have.

If you are a fan of disk files, you will find BASIC09 different

from the Microsoft BASIC in the CoCo, perhaps a tad more complex, but also more powerful. With one statement such as PUT #PATH, myfile, you can save a whole 10,000-byte data structure to disk as a machine code dump, which is fast and easy. Load it back with GET #PATH, myfile, which is as equally easy and fast.

BASIC09 is designed to encourage writing program modules. Subroutines are named (no more wondering what GOSUB 33 means), stored separately from other modules and run by name. This can save memory since only those procedures being used need be in memory. Such is not the case with PASCAL, where procedures must be defined and be in memory before they can be used. Variable names are local to modules, that is, you can use the same variable name in a number of modules to mean similar things. For example, "count" in the main program does not change when "count" in a subroutine is incremented, unless you specifically write the program so that happens. Long variable names are significant so that "count1" is different from "count2."

Perhaps I have left the status of PASCAL as a fuzzy choice. In fact, the choice between PASCAL and BASIC09 under OS-9 is not easy. One reason to choose PASCAL is that its programs can be compiled to machine language. Those who intend to take high school or college programming courses should opt for PASCAL simply because most institutions encourage beginning students to take PASCAL. Further advanced placement tests are standardized on PASCAL.

For the rest of us, the transition from BASIC to BASIC09 is easier than the transition to PASCAL. And, "byteheads" will probably take the next step to PASCAL as well.

To get started, buy the BASIC09 Compiler (\$99.95) from your Radio Shack store. Also, buy *The Official BASIC09 Tour Guide* by Dale Puckett, which is now available from Radio Shack. Then, follow the rest of this article step by step.

When BASIC09 first appeared, the cry went up, "It won't load!" It was a directory problem. Under OS-9, if you just type the procedure name, that procedure must be in memory or in your CMDS directory to load and execute. The BASIC09 disk comes without a CMDS directory. Therefore, the very first order of business is to copy BASIC09 from the distribution disk to the CMDS directory on a system disk or to the CMDS directory on another disk if you are running two or more drives. Unlike C, BASIC09 does not require more than one disk drive.

There are two filenames on the distribution disk, *BASIC09* and *RUNB*. *BASIC09* includes the interpreter, an editor that is nice for a line editor, which as a class, ranges

from poor to horrible, and a debugger. *RUNB* is a special interpreter that runs packed BASIC09 modules. *RUNB* is half the size of *BASIC09*, and packed BASIC09 modules are a quarter to a third smaller than their source code. Packed modules run faster, though unpacked ones are fast compared to Color BASIC. Downstream, you will need to have *RUNB* in the CMDS directory along with packed BASIC09 modules.

I am back to a practice I follow under Disk BASIC. I make up a single disk for an application that includes the program modules and my working files. This way, I stick the disk in, boot the application, load any work files and go. This works even better under OS-9 where I have a special start-up file that automatically boots the application, setting a large memory buffer automatically.

I make an OS-9 system disk that includes *OS9boot* and its various utility procedures in the CMDS directory. Some of the procedures that come with OS-9 are never used with BASIC09 and should be discarded while making your BASIC09 system disk. There are a number of ways to approach this project, depending on how fancy you want to get. We will show an easy way, then refer to some more complex approaches that utilize more of OS-9's power.

### Making a Single Drive BASIC09 Disk

First, format a disk. Type `FORMAT /D0` at the OS-9 prompt. OS-9 loads the FORMAT modules and asks if you are ready. Now remove your system disk from Drive 0 and insert a fresh disk. Press 'Y' and that disk will be formatted.

The second step is to back up a system disk onto the newly formatted one. Exact examples of how to do this are shown on pages 63 and 64 of your red *OS-9 Commands Manual* for either two-drive or single-drive systems, so I won't duplicate them here. At this point, put your original system disk safely away and work with the backup. Type `FREE` and you will see that of 630 sectors: 84 are free and the largest block is 81 sectors (when using Version 01.01 of OS-9). This is on a 35-track disk.

Though 84 sectors is not much to work with (particularly when we have yet to copy *BASIC09* and *RUNB* onto the disk), there is quite a bit on the disk you will never need with BASIC09, so housecleaning is in order. We can start with the CMDS directory, which starts out like this.

Directory of /D0/CMDS 11:36:40

asm	attr	backup
binex	build	cmp
cobbler	copy	date
dcheck	debug	del
deldir	dir	display
dsave	dump	echo
edit	exbin	format
free	ident	link
list	load	login
mkdir	mdir	merge
mfree	os9gen	prnterr
procs	pwd	pxd
rename	save	setime
shell	sleep	tee
tmode	tsmon	unlink
verify	xmode	

ASM is the assembler, which you won't need, so take it

out. BINEX and EXBIN are worthless here, too, so pitch them. CMP is useful to see if files are identical, but also not worth keeping here. DCHECK and DEBUG can both go, and you can dump DUMP. LOGIN and TSMON are for use with an attached terminal intended for the multi-user mode, so take them both out; TEE can go, too.

Here is the easy way to clean house. Know that when deleting files from your data directory, you only need to specify the filename and not the whole pathlist. All the files listed here are in the CMDS directory. Therefore, make the CMDS directory the data directory by typing `CHD /D0/CMDS`. Now just a few typed lines will clean things up.

```
OS9>DEL ASM BINEX CMP DCHECK DEBUG DUMP
OS9>DEL LOGIN TEE TSMON
OS9>CHD /D0
```

After some OS-9 commands, a number of filenames may be entered up to the input buffer limit. The advantage of this is both reduced typing and speed since DEL is loaded only once to work on a number of entries.

Next we turn our attention to the DEFS files. These are only used with the assembler we just deleted, so we do the same with the DEFS files and their directory.

```
OS9>CHD /D0/DEFS
OS9>DEL OS9Def's RBFDef's SCFDef's SysType def'sfile
OS9>DELDIR DEFS
```

At this point, OS-9 asks a cogent question to which I answer 'Y' and the directory goes away as well. Don't forget to do a `CHD /D0` to return your data directory to D0.

Now we can copy *BASIC09* and *RUNB* to our commands directory. I suggest you type `LOAD COPY` to save a bit of time. Single drive copy works like single drive backup in terms of disk swapping and ready messages. The command lines should look like this:

```
OS9>COPY /D0/basic09 /D0/CMDS/basic09 -s #30K
OS9>COPY /D0/runb /D0/CMDS/runb -s #30K
```

The "-s" tells OS-9 you want a single drive copy and "#30K" allocates 30K bytes of memory buffer for the job. The larger the memory buffer, the fewer times you need to swap disks.

Now our CMDS directory looks like this:

Directory of /d1/cmds 21:39:33

BASIC09	attr	backup
runb	build	cobbler
copy	date	del
deldir	dir	display
dsave	echo	edit
format	free	ident
link	list	load
mkdir	mdir	merge
mfree	os9gen	prnterr
procs	pwd	pxd
rename	save	setime
shell	sleep	tee
tmode	unlink	verify
xmode		

And we still have some room on the disk, as `FREE` will show.

continued on P 61



# VERY BASICALLY OS9

by Jack Fricker

OK. This month we are going to get back to the basics of OS-9 for those who are new to OS-9 and try to answer the questions most commonly asked.

In this article I am going to assume that you have just been to TANDY and bought a copy of OS-9 and BASIC09 and have just arrived home with them. You open the boxes look at the 3 disks and 4 manuals and say to yourself where do we start. You may even think that this is going to be TOO HARD to learn so why bother. You probably thought much the same when you first bought your computer home but you managed to learn how to use it didn't you? If you answered no you should go back and learn the basics of how to use it before you start on OS-9.

Well if you haven't been discouraged and have read this far that was the end of the hard sell. We are now going to get back to the point when you have opened the box.

The first thing to do is back up the master disk. First place a write protect tab over the write protect notch. The write protect notch is the small square missing from the side of the diskette. If you cover this with a piece of tape or a sticker then nothing can be written onto the disk.

Before you can backup the disk you must first get OS-9 up and running. If your Disk Basic has the DOS command (OS9 on some) all that you need to do is type DOS or OS9 when you have inserted the System Master Diskette into drive 0.

If your Disk Basic doesn't have either of these fear not, you have also been catered for. There should be a diskette marked Boot Disk in the package with the System Disk. If you do a DIR of this disk there should be two files on there, the one called "\*" is the one that we want. Insert this in drive 0 and type RUN "\*" and press the enter key. The screen will clear and ask you if you wish to check the speed of the drives or if you wish to boot OS-9. Answer OS-9 and you are on your way.

The loading and executing of OS-9 takes a little time. The screen should clear and the words OS9 boot should appear in the centre of the screen.

The next message that should appear will look something like this. It will be different for each version of OS-9.

```
OS-9 Level One
RS VERSION 01.01.00
COPYRIGHT 1980 BY MOTOROLLA
AND MICROWARE SYSTEMS CORP.
REPRODUCED UNDER LICENSE
TO TANDY CORP.
ALL RIGHTS RESERVED
```

```
yy/mm/dd hh:mm:ss
TIME ?
```

The prompt is asking you to enter the date and time. When you enter this it will start the SYSTEM CLOCK and print the date and time at various times. It will also set the date on any files so that you know for instance the last time a file was edited or when it was created. The CLOCK is more important than you might think because what we are about to do will use the date of the system clock.

The next thing to do is to make 2 backup copies of the master system disk. Why 2 you may ask? Its because you are going to modify one of them and if you make a mistake you will need the other disk to boot OS-9 again.

The first step in making a backup system disk is to format a blank disk (that makes sense doesn't it?). I am going to take you step by step through the procedure to format and backup using single or twin disk drives.

Although OS-9 will work quite well on a single drive two drives are better and will make these procedures easier and faster. Anyway, the first step in formatting a blank disk in drive 0 is to type "format /d0". Leave the distribution master disk in drive 0 while you are typing this. This is the reason that I said to place a write protect tab on the disk. After pressing enter the following

will appear.

```
Format /d0 y/n
```

At this point you remove the distribution disk and insert the blank unformatted disk into drive 0 and press Y for yes. Just to make sure you really wish to do this it will ask you if you are ready. If you again type Y then it is too late to back out, that disk is about to be erased and formatted. The reason that you are asked twice is because formatting will erase any data on the disk that you may not wish erased.

After a short time you will be asked for a volume name. This name can be up to 32 characters long. This name will be written to the disk, but since we will be backing up onto this disk you can type anything you like in answer to this question. Backup will write the name of the disk that is being copied over the name you type in.

After you type your response & press enter you will see a number of HEXADECIMAL numbers on the screen. These numbers are the sectors being put on the disk. At the end of these numbers you will see the total number of sectors is \$276. Repeat this procedure for the other disk.

Now that we have a couple of blank formatted disks maybe we should put something on them.

If you only have one disk drive you must re-insert your master system disk into drive 0 & type BACKUP /d0. The Computer will respond with Ready to backup /d0. If you type 'y' you will be asked to insert the destination disk in drive 0. Then you will be asked if disk so & so is the one you want.

If you have 2 disk drives insert the distribution system disk in drive 0 and the new disk in drive 1. Type BACKUP & the prompt will read "Ready to backup from /d0 to /d1 y/n". When you type 'y' you will be asked if disk name (the name you entered before) is the one you want.

The reason that you are asked if you really wish to backup onto the disk is simple. When a backup of one disk onto another is done any and all information on the disk being copied to is written over including the name and date of creation. This is the reason that I said earlier when we created the disk not to worry about giving the disk a proper name. The creation date is the only thing that is not copied over from the original disk, it is given the current date instead.

OK. Now that you have 2 backups of your Master Distribution disk. From now on we'll call them your System disk and Backup System disk. Put your distribution disk away in a safe place because we should never

need to use it again.

Instead you will use your newly created system disk. Put the system disk in drive 0 and type CHD /D0. Chd means CHange Data directory and /d0 means drive 0 (of course). Next type CHX /D0/CMDS. Chx means CHange eXecution directory. /cmds is the commands directory which is where a list of all the commands and where on the disk they are stored.

The chd and chx are commands but you will not find them in the commands directory because they are part of OS-9 and are in memory.

The /d0 and /d0/cmds are called pathlists. Pathlist is a word you will have to get used to when using OS-9 because I will be using it and the Manuals make constant use of

it.

Parameter is another word that has to be learned. What it means is something that has to be passed from one thing to another. In this case pathlist is a parameter that is passed to the calling program chx or chd.

All these are mentioned in the manuals so I have mentioned them to help you when you read them. They contain all the things that you need to know so read them very carefully and fully.

If you have any questions about the user groups or the public domain software you may contact me c/- the Australian Rainbow or P.O.Box 306 Clayfield 4011.

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"COLOR COMPUTER DISK" created on: 85/11/17

Capacity: 630 sectors (1-sector clusters)

193 Free sectors, largest block 129 sectors

One last item to attend to is the start-up file.

```
TMODE .1 -UPC
XMODE /P BAUD=4 -UPC
PRINTERR
SETIME </TERM
LOAD BASIC09
EX BASIC09 #12K </TERM
```

TMODE .1 -UPC sets the terminal for upper- and lowercase. My experiments indicate this must be in all start-up files when lowercase is desired. It can be issued from the keyboard as well. Lowercase is used in BASIC09.

XMODE /P BAUD=4 -UPC sets the printer output to 2400 Baud. Use '2' for 600 Baud and '3' for 1200 Baud. PRINTERR enables OS-9 to get error messages from the disk replacing numbers; it's nice to have. SETIME </TERM gets the date and time entries from the keyboard. Without </TERM, SETIME looks for input from the disk and the system locks up. This is an important point that some of us have learned through much suffering. A start-up file is set up to interact with the disk drive unless

instructed otherwise.

We load BASIC09 (the program) so we can go back and forth between OS-9 and BASIC09 (the language) without having to load BASIC09 each time. Finally, BASIC09 is executed using EX, which saves forming another shell. >/TERM must be included or BASIC09 looks for its input from disk.

At this point you have one disk that automatically boots into BASIC09 and has space for some program files. However, we have not optimized memory. On booting, OS-9 loads a standard set of modules. A few of these won't be used and can be tossed, making room for either larger program files in memory or providing space for other modules such as DIR, which you might want in memory. Elsewhere in this issue, Donald Dollberg discusses optimizing your OS-9 boot to tailor in-memory modules to just those you want. His article, "Creating OS-9 System Disks," starts on Page 224.

When you have finished customizing your BASIC09 working disk, keep it as a master disk and make backups for working disks. When you start a new programming project, it's a good idea to start with a new working disk, as well.

Next month, we will pop our completely customized BASIC09 disk in the drive and start programming. ☺

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# JUNK FILTER

by Ross McKay

(Many people appreciated seeing Rosko's program in the magazine last month. These simple, easy to follow programs are a great starting point for new OS-9'ers, and we'd encourage anyone who is not an expert to forward for publication their 'little' OS-9 progs.)

OS-9 is proving to be a very enjoyable environment to work in. Many of you are a bit daunted at the prospect of starting something new - especially when it looks a bit complex.

But if you give it a go, you'll like it - so get

into it! G.)

I've already had some calls from some people following the program last month - thanks, it was nice to hear from you!

Here is a little utility written in Basic 09 which will filter out 'junk' characters from text files.

These include line feeds and any graphics and control characters.

I wrote this to filter my BBS dumps, which ran to many pages with the extra line feeds.

## PROCEDURE filt

```
(* FILT 1.0
```

```
(* by --- Rosko ! ---
```

```
(* usage: <run> filt("filename")
```

```
(* will remove non-cr's outside
```

```
(* range chr$(32)-chr$(127)
```

```
(* requires OS-9 Rename
```

```
PARAM file1:STRING
```

```
DIM infile,outfile:INTEGER
```

```
DIM char,lf:STRING[1]
```

```
lf:=CHR$(10)
```

```
OPEN #infile,file1:READ
```

```
CREATE #outfile,"temp":WRITE
```

```
WHILE NOT(EOF(#infile)) DO
```

```
GET #infile,char
```

```
IF char>CHR$(31) AND char<CHR$(128) OR char=CHR$(13) THEN
```

```
PUT #outfile,char
```

```
PUT #1,char
```

```
ENDIF
```

```
IF char=CHR$(13) THEN
```

```
PUT #1,lf
```

```
ENDIF
```

```
ENDWHILE
```

```
CLOSE #infile
```

```
CLOSE #outfile
```

```
DELETE file1
```

```
SHELL "rename temp "+file1
```

*Hint...*

## Formatting Diskettes

Some CoCo users have reported problems with formatting more than one disk in succession. The CoCo uses a technique called "write precompensation" on the more critical inner tracks of a disk; for some reason, Disk BASIC doesn't turn off the feature after a DSKINI is completed. If you need to format more than one disk at a time, enter POKE 113,0 and press the Reset button after each disk.

*Hint...*

## Slow Scrolling through Orange

Here's a powerful little POKE that slows your scrolling by creating a horizontal LIST. Type POKE 359,60 and you'll see what we mean. Add a colon (:) and SCREEN0,1 and you'll be slow-scrolling across an orange screen. To return to the green screen at full tilt, just type POKE 359,126.

AUSTRALIAN

# RAINBOW

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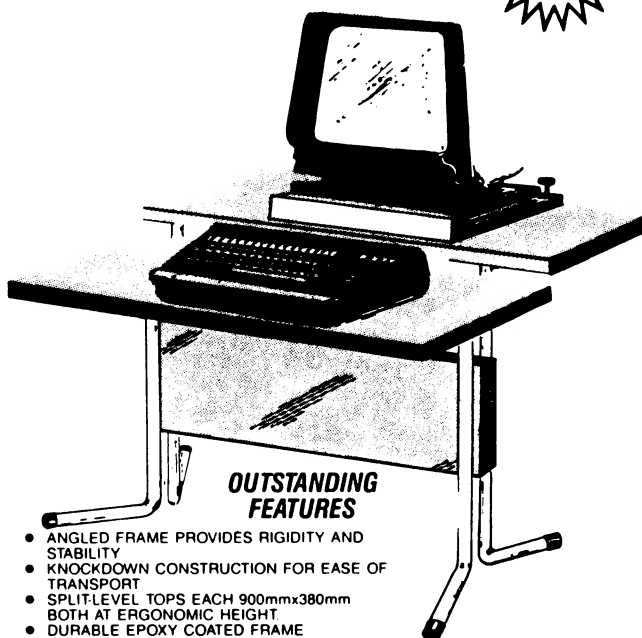
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